

Evaluation of Quality and Impact at SLU

Supplement

KoN09

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CONTENTS

SUPPLEMENT

REPORTS

R 1	Bibliometric indicators for research fields at SLU	4
R 2	Reports from the Scientific panels on research fields and individual units	21
1	Economics and Statistics	
2	Landscape Architecture, Urban and Rural Development	
3	Ecology and Environmental Sciences	
4	Food Science and Safety	
5	Animal Health	
6	Animal Husbandry	
7	Biomedicine	
8	Forest Management and Products	
9	Biosystems Technology	
10	Plant Protection	
11	Plant Production	
12	Soil and Aquatic Sciences	
13	Plant Science	
14	Genetics and Breeding	
15	Chemistry, Molecular Biology and Microbiology	
R 3	SLU ur ett intressentperspektiv (report from in-depth interviews with stakeholders; in Swedish)	482
R 4	Reports from Stakeholder panels (in Swedish)	499
I.	Livsmedel (Food)	
II.	Djurhälsa och djurvälstånd (Animal Health and Welfare)	
III.	Energi- och industriråvaror (Raw Materials for Energy and Industry)	
IV.	Samhällsplanering, natur och miljö (Spatial Planning, Environment and Nature)	
V.	Fortlöpande miljöanalys, Foma (Environmental Monitoring and Assessment)	

BACKGROUND DOCUMENTS

B 1	Template for UoA's self-assessments	544
B 2	KoN performance indicators (description of bibliometric analysis)	559
B 3	Requirements for members in Scientific panels	571
B 4	Schedule for Scientific panels	574
B 5	Template for reports from Scientific panels	577
B 6	Template for reports from Stakeholder panels (in Swedish)	582

R 1

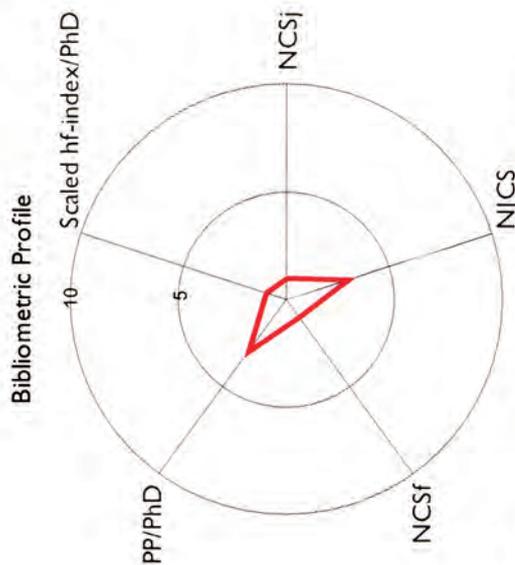
Bibliometric indicators for research fields at SLU

Bibliometric indicators for research fields at SLU

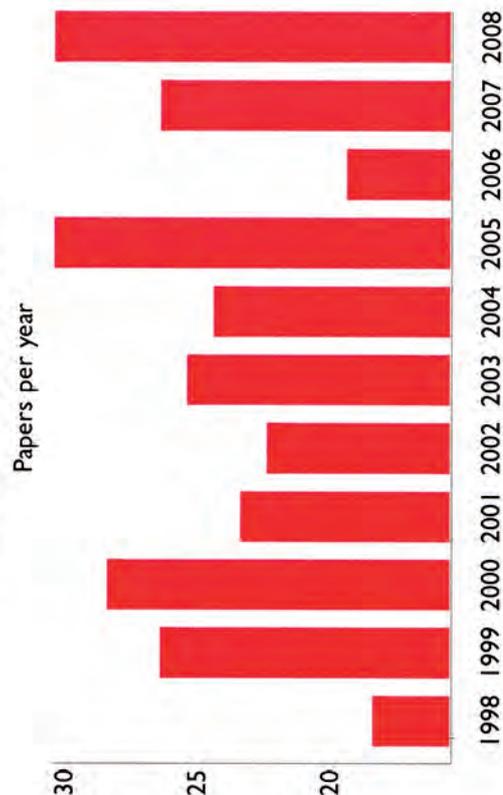
Bibliometric analyses made by Assoc. Prof. Ulf Sandström. Methodology and indicators are described in detail in Supplement B 2 ('KoN performance indicators').

ECONOMICS AND STATISTICS (1) - BIBLIOMETRIC INDICATORS

Number of papers (P)	271
Number of papers (articles, letters, proceedings papers, reviews) published by ECONOMICS AND STATISTICS during 1998-2008.	
Number of fractionalized papers (Frac P)	135.1
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	3.9
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	0.71
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	1
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	0.64
CPP normalized in relation to mean citation rate of the ECONOMICS AND STATISTICS sub-field set (average=1,00).	
TOP 5% (TOP5%)	5.4
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	2.19
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	1.3
The h-index, taking the number of authors on each paper into account.	
g-Index per researcher (g-Index/PhD)	3.33
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-Index per researcher (Hf-Index/PhD)	1.8
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.75
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

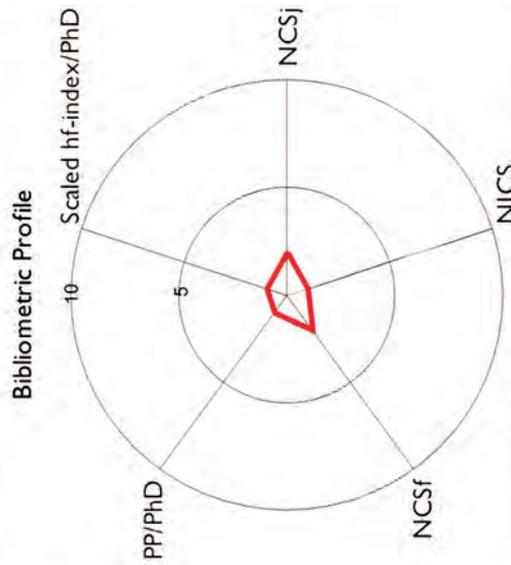


Decentile rank within SLU on five indicators (10=high rank).
Figure is further explained in the accompanying Report to Panels on Performance Indicators.

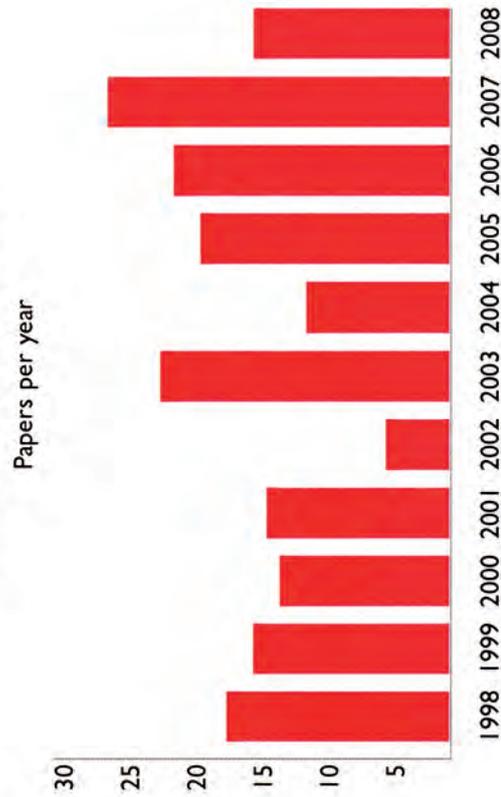


LANDSCAPE ARCHITECTURE, URBAN AND RURAL DEVELOPMENT (2) - BIBLIOMETRIC INDICATORS

Number of papers (P)	178
Number of papers (articles, letters, proceedings papers, reviews) published by LANDSCAPE ARCHITECTURE, URBAN AND RURAL DEVELOPMENT during 1998-2008.	
Number of fractionalized papers (Frac P)	78.5
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	5.47
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	0.96
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	0.94
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	0.89
CPP normalized in relation to mean citation rate of the LANDSCAPE ARCHITECTURE, URBAN AND RURAL DEVELOPMENT sub-field set (average=1,00).	
TOP 5% (TOP5%)	3.9
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	1.47
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	0.84
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	2.09
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher (Hf-Index/PhD)	1.01
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.54
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	



Decentile rank within SLU on five indicators (10=high rank).
Figure is further explained in the accompanying Report to Panels on Performance Indicators.



ECOLOGY AND ENVIRONMENTAL SCIENCES (3) - BIBLIOMETRIC INDICATORS

Number of papers (P) 1192

Number of papers (articles, letters, proceedings papers, reviews) published by ECOLOGY AND ENVIRONMENTAL SCIENCES during 1998-2008.

Number of fractionalized papers (Frac P) 480.9

Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.

Citations Per Paper (CPP) 13.66

Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.

Journal Normalized Citation Score (NCSj) 1.19

CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).

Normalized Journal Citation Score (NCSf) 1.23

Impact of the journal set in relation to their respective sub-fields (average=1,00), subfields defined by Thomson Reuters.

Field Normalized Citation Score (NCSf) 1.42

CPP normalized in relation to mean citation rate of the ECOLOGY AND ENVIRONMENTAL SCIENCES sub-field set (average=1,00).

TOP 5% (TOP5%) 15.8

Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.

Hirsch Index per researcher (h-Index/PhD) 7.2

The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.

Fractionalized Hirsch Index per researcher (hf-Index/PhD) 4.1

The h-index, taking the number of authors on each paper into account.

g-index per researcher (g-Index/PhD) 11.15

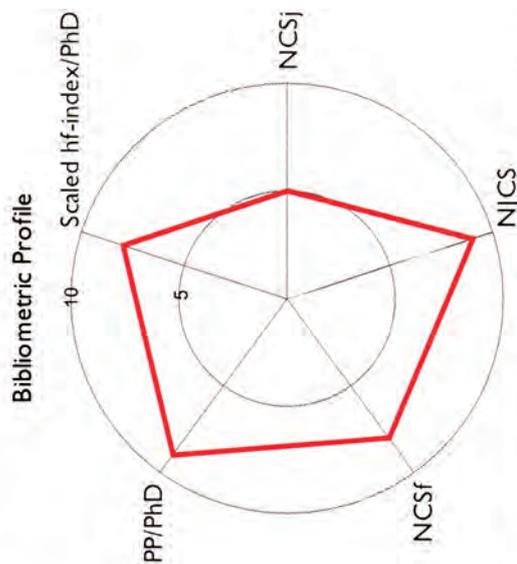
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g² citations.

Scaled hf-index per researcher(Hf-Index/PhD) 4.49

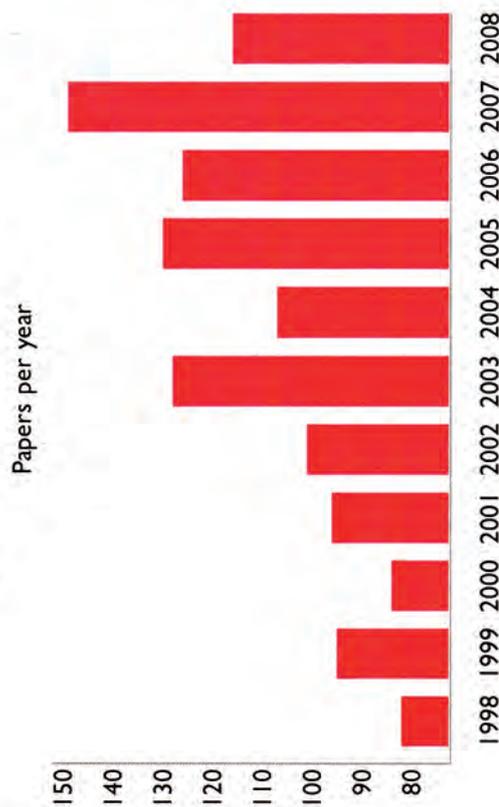
Normalization of the hf-index based on citation reference values per ISI fields.

Publication Points per researcher (PP/PhD) 1.14

Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.

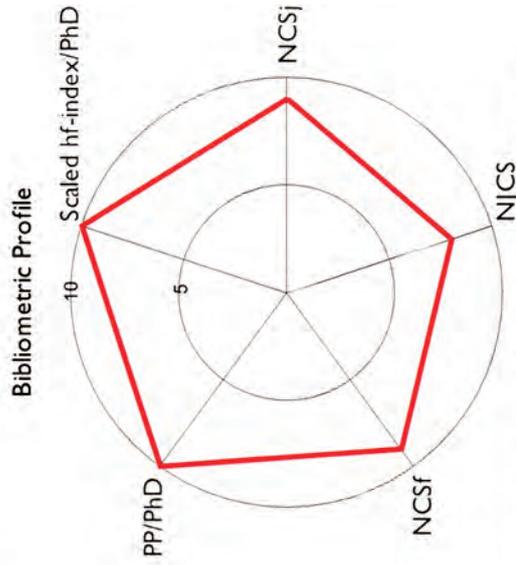


Decentile rank within SLU on five indicators (10=high rank).
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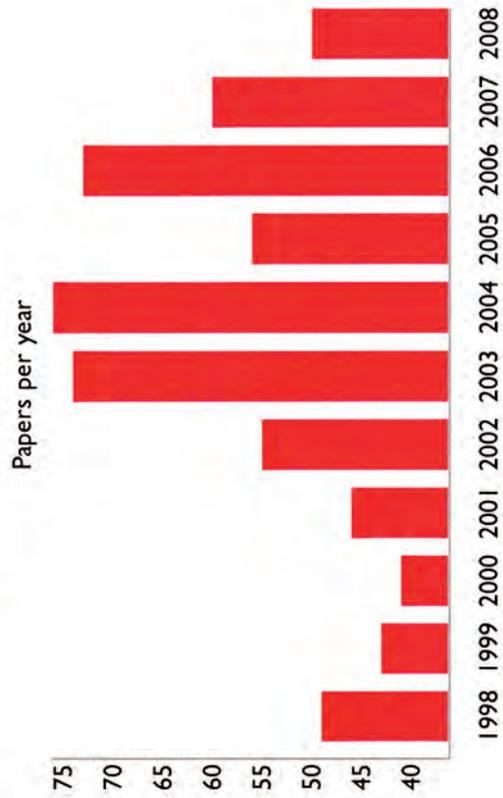


FOOD SCIENCE AND SAFETY (4) - BIBLIOMETRIC INDICATORS

Number of papers (P)	612
Number of papers (articles, letters, proceedings papers, reviews) published by FOOD SCIENCE AND SAFETY during 1998-2008.	
Number of fractionalized papers (Frac P)	218.9
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	10.69
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.27
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1.00).	
Normalized Journal Citation Score (NJCS)	1.19
Impact of the journal set in relation to their respective sub-fields (average=1.00), subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.45
CPP normalized in relation to mean citation rate of the FOOD SCIENCE AND SAFETY sub-field set (average=1.00).	
TOP 5% (TOP5%)	15.5
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	11.73
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	4.99
The h-index, taking the number of authors on each paper into account.	
g-Index per researcher (g-Index/PhD)	17.96
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher (Hf-Index/PhD)	6.05
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	1.81
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

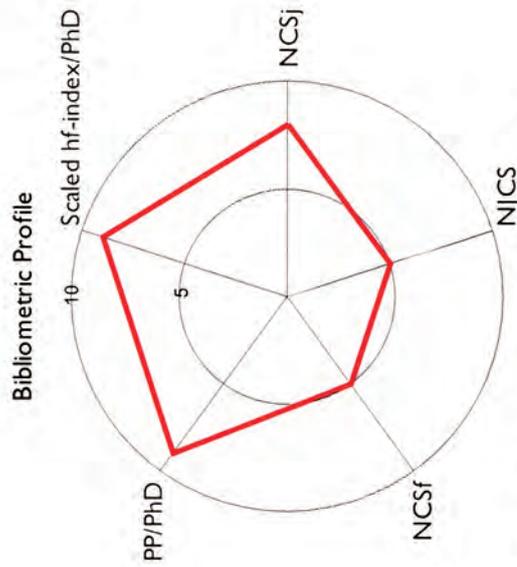


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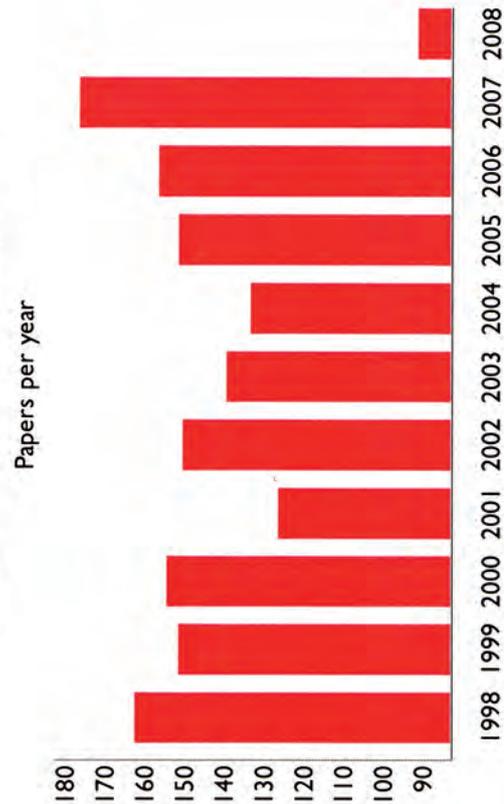


ANIMAL HEALTH (5) - BIBLIOMETRIC INDICATORS

Number of papers (P)	1567
Number of papers (articles, letters, proceedings papers, reviews) published by ANIMAL HEALTH during 1998-2008.	
Number of fractionalized papers (Frac P)	480.8
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	8.42
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.23
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1.00).	
Normalized Journal Citation Score (NJCS)	1.09
Impact of the journal set in relation to their respective sub-fields (average=1.00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.32
CPP normalized in relation to mean citation rate of the ANIMAL HEALTH sub-field set (average=1.00).	
TOP 5% (TOP5%)	11.5
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	9.29
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	4.06
The h-index, taking the number of authors on each paper into account.	
g-Index per researcher (g-Index/PhD)	14.28
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher(Hf-Index/PhD)	4.53
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	1.48
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

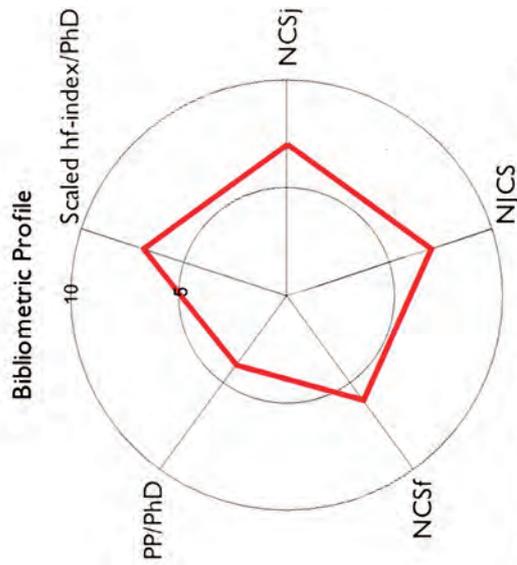


Decentile rank within SLU on five indicators (10=high rank).
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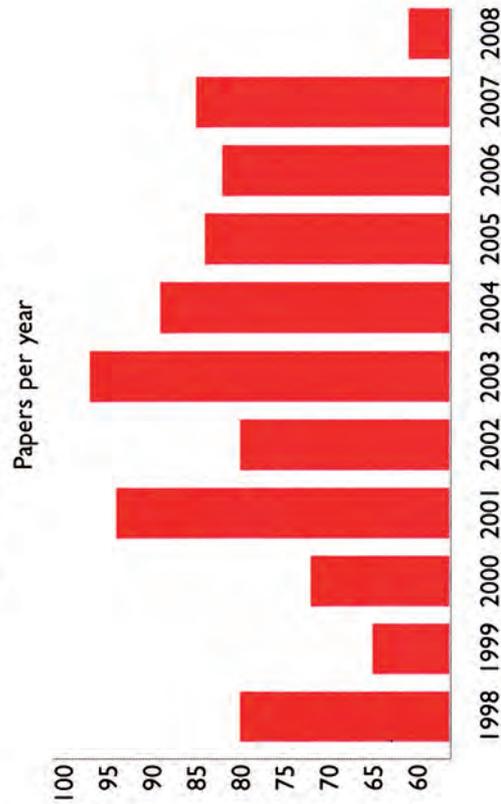


ANIMAL HUSBANDRY (6) - BIBLIOMETRIC INDICATORS

Number of papers (P)	878
Number of papers (articles, letters, proceedings papers, reviews) published by ANIMAL HUSBANDRY during 1998-2008.	
Number of fractionalized papers (Frac P)	333.9
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	7.7
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.22
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	1.14
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.34
CPP normalized in relation to mean citation rate of the ANIMAL HUSBANDRY sub-field set (average=1,00).	
TOP 5% (TOP5%)	13.4
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	6.33
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	3.07
The h-index, taking the number of authors on each paper into account.	
g-Index per researcher (g-Index/PhD)	9.59
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-Index per researcher(Hf-Index/PhD)	3.88
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.79
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

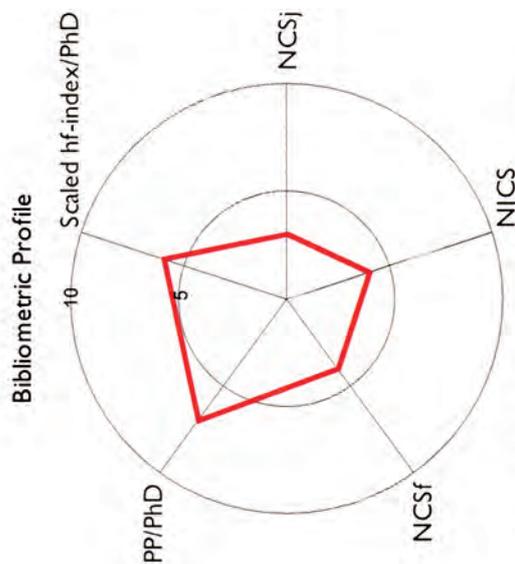


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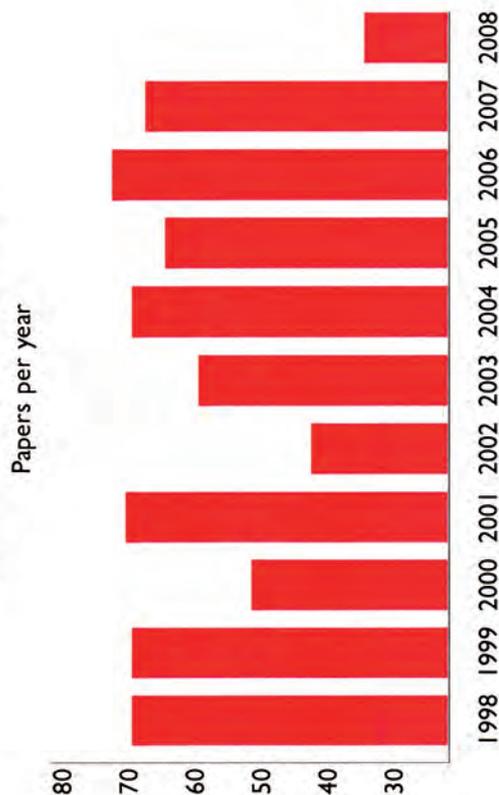


BIOMEDICINE (7) - BIBLIOMETRIC INDICATORS

Number of papers (P)	655
Number of papers (articles, letters, proceedings papers, reviews) published by BIOMEDICINE during 1998-2008.	
Number of fractionalized papers (Frac P)	178.3
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	12.45
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.02
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1.00).	
Normalized Journal Citation Score (NJCS)	1.04
Impact of the journal set in relation to their respective sub-fields (average=1.00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.09
CPP normalized in relation to mean citation rate of the BIOMEDICINE sub-field set (average=1.00).	
TOP 5% (TOP5%)	9.5
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	10.14
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	4.24
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	15.56
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher(Hf-index/PhD)	3.84
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.92
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	



Decentile rank within SLU on five indicators (10=high rank).
Figure is further explained in the accompanying Report to Panels on Performance Indicators.



FOREST MANAGEMENT AND PRODUCTS (8) - BIBLIOMETRIC INDICATORS

Number of papers (P) 726

Number of papers (articles, letters, proceedings papers, reviews) published by FOREST MANAGEMENT AND PRODUCTS during 1998-2008.

Number of fractionalized papers (Frac P) 298.4

Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.

Citations Per Paper (CPP) 11.8

Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.

Journal Normalized Citation Score (NCSj) 1.25

CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).

Normalized Journal Citation Score (NJCS) 1.14

Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.

Field Normalized Citation Score (NCSf) 1.42

CPP normalized in relation to mean citation rate of the FOREST MANAGEMENT AND PRODUCTS sub-field set (average=1,00).

TOP 5% (TOP5%) 14

Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.

Hirsch Index per researcher (h-Index/PhD) 4.91

The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.

Fractionalized Hirsch Index per researcher (hf-Index/PhD) 2.8

The h-index, taking the number of authors on each paper into account.

g-index per researcher (g-Index/PhD) 7.57

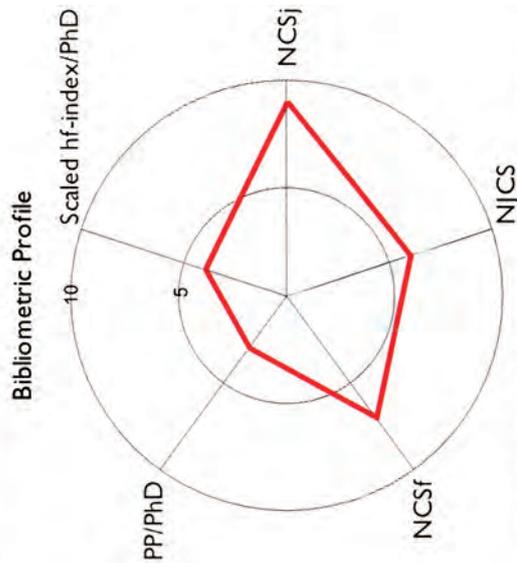
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g² citations.

Scaled hf-index per researcher (Hf-Index/PhD) 3.13

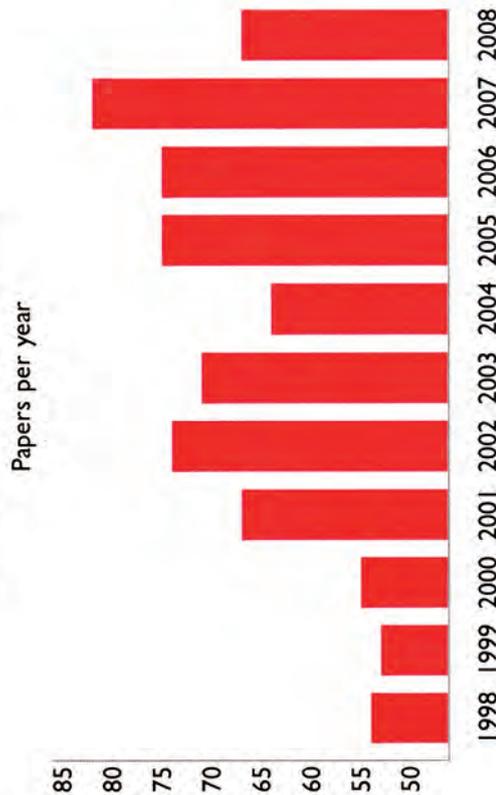
Normalization of the hf-index based on citation reference values per ISI fields.

Publication Points per researcher (PP/PhD) 0.62

Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.

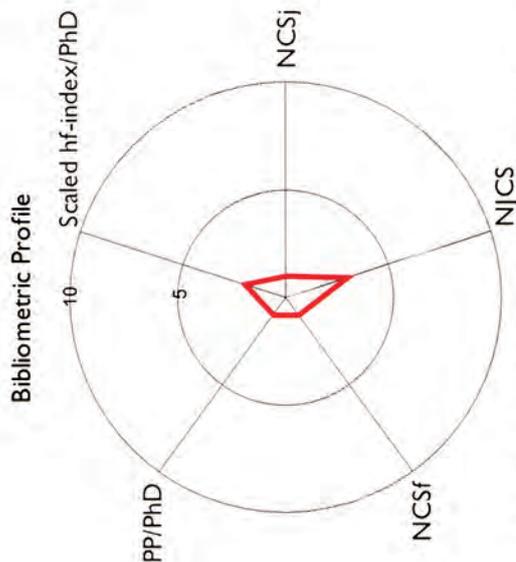


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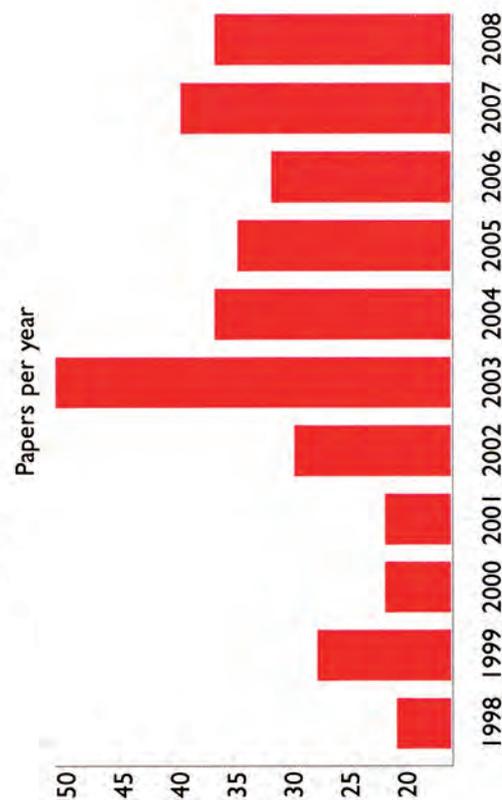


BIOSYSTEMS TECHNOLOGY (9) - BIBLIOMETRIC INDICATORS

Number of papers (P)	345
Number of papers (articles, letters, proceedings papers, reviews) published by BIOSYSTEMS TECHNOLOGY during 1998-2008.	
Number of fractionalized papers (Frac P)	171.6
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	5.6
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	0.87
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	1.04
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	0.87
CPP normalized in relation to mean citation rate of the BIOSYSTEMS TECHNOLOGY sub-field set (average=1,00).	
TOP 5% (TOP5%)	5.4
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	3.14
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	1.75
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	4.21
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher(Hf-Index/PhD)	2.09
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.49
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

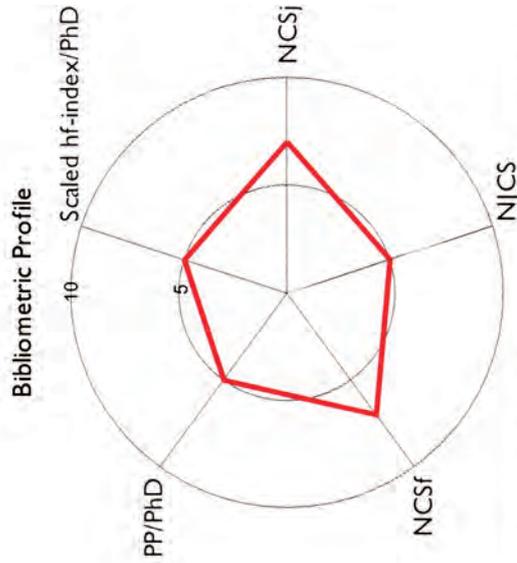


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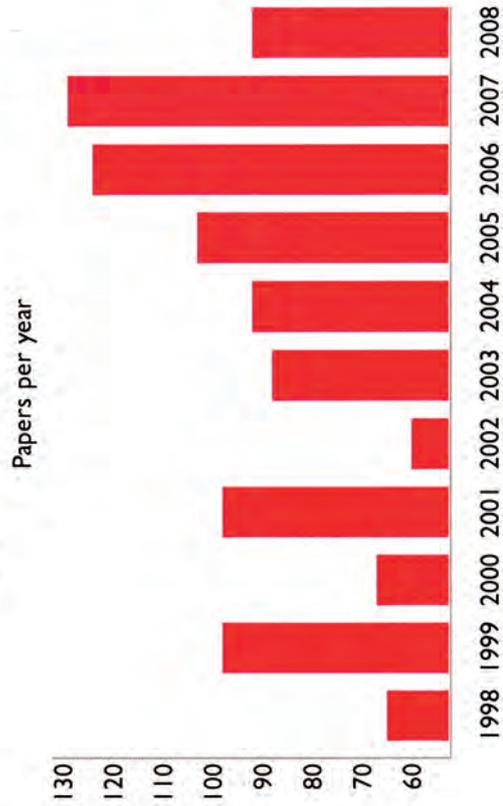


PLANT PROTECTION (10) - BIBLIOMETRIC INDICATORS

Number of papers (P)	994
Number of papers (articles, letters, proceedings papers, reviews) published by PLANT PROTECTION during 1998-2008.	
Number of fractionalized papers (Frac P)	377.9
Sum of author fractionalized papers during 1998-2008; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	10.61
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.21
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1.00).	
Normalized Journal Citation Score (NJCS)	1.11
Impact of the journal set in relation to their respective sub-fields (average=1.00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.34
CPP normalized in relation to mean citation rate of the PLANT PROTECTION sub-field set (average=1.00).	
TOP 5% (TOP5%)	13.3
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	6.92
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	3.55
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	10.82
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher (Hf-Index/PhD)	3.78
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.8
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

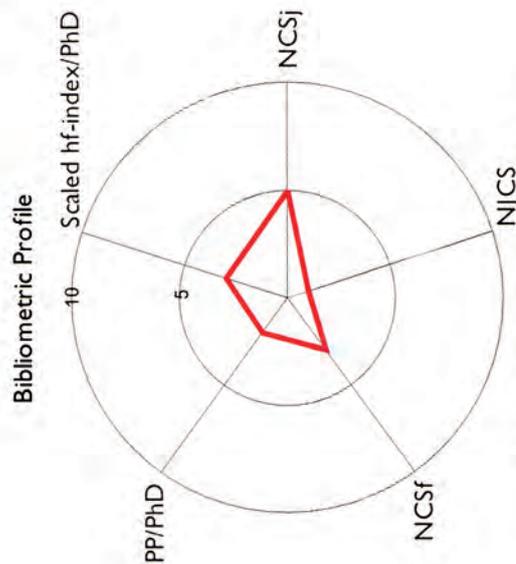


Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.

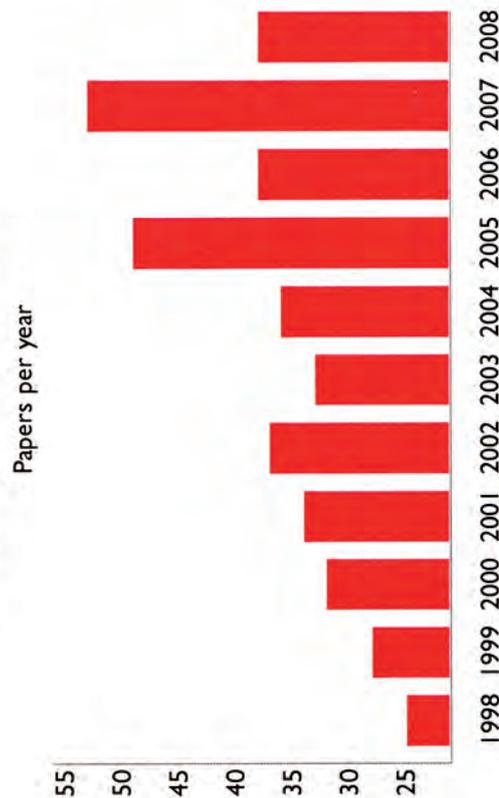


PLANT PRODUCTION (11) - BIBLIOMETRIC INDICATORS

Number of papers (P)	392
Number of papers (articles, letters, proceedings papers, reviews) published by PLANT PRODUCTION during 1998-2008.	
Number of fractionalized papers (Frac P)	160
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	8.1
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.11
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	0.94
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	0.99
CPP normalized in relation to mean citation rate of the PLANT PRODUCTION sub-field set (average=1,00).	
TOP 5% (TOP5%)	8.1
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	4.08
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	2.37
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	6.37
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher(Hf-Index/PhD)	2.82
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.58
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	



Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.



SOIL AND AQUATIC SCIENCES (12) - BIBLIOMETRIC INDICATORS

Number of papers (P) 1047

Number of papers (articles, letters, reviews) published by SOIL AND AQUATIC SCIENCES during 1998-2008.

Number of fractionalized papers (Frac P) 406.8

Sum of author fractionalized papers during 1998-2008; fractions depending on number of authors per paper.

Citations Per Paper (CPP) 12.5

Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.

Journal Normalized Citation Score (NCSj) 1.3

CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).

Normalized Journal Citation Score (NJCS) 1.2

Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.

Field Normalized Citation Score (NCSf) 1.48

CPP normalized in relation to mean citation rate of the SOIL AND AQUATIC SCIENCES sub-field set (average=1,00).

TOP 5% (TOP5%) 16.9

Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.

Hirsch Index per researcher (h-Index/PhD) 6.9

The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.

Fractionalized Hirsch Index per researcher (hf-Index/PhD) 3.64

The h-index, taking the number of authors on each paper into account.

g-Index per researcher (g-Index/PhD) 10.59

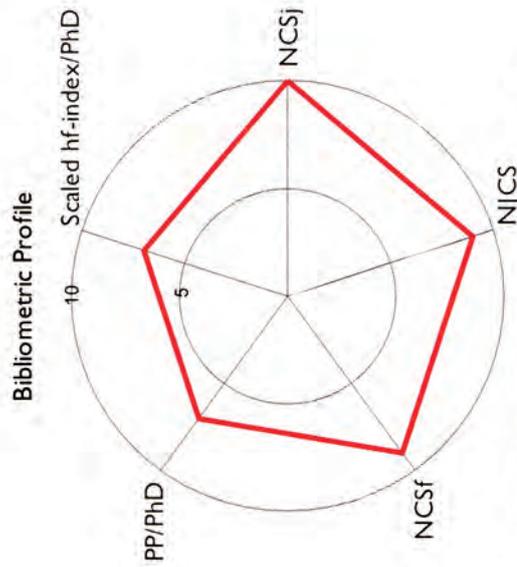
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g² citations.

Scaled hf-index per researcher(Hf-Index/PhD) 4.02

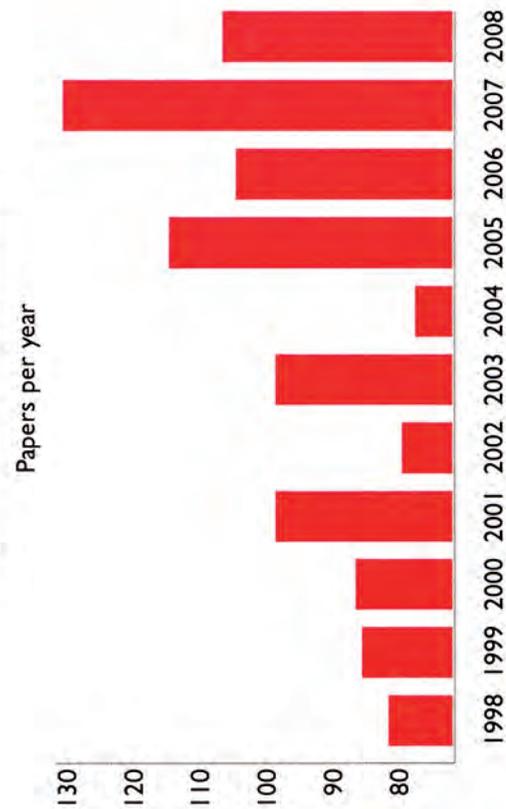
Normalization of the hf-index based on citation reference values per ISI fields.

Publication Points per researcher (PP/PhD) 1

Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.

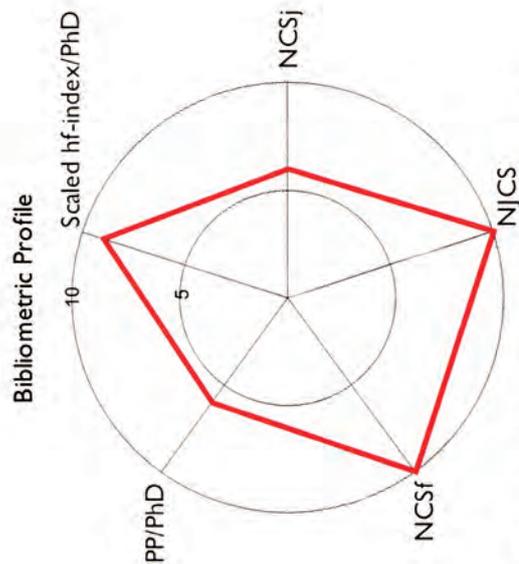


Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.

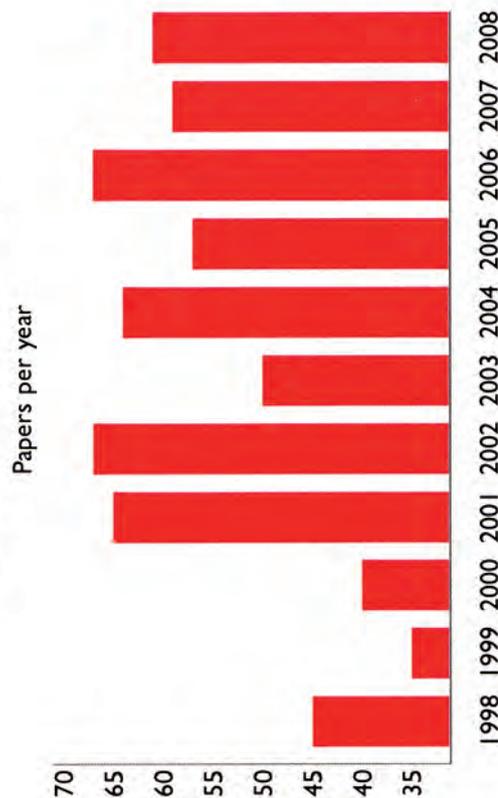


PLANT SCIENCE (13) - BIBLIOMETRIC INDICATORS

Number of papers (P)	599
Number of papers (articles, letters, proceedings papers, reviews) published by PLANT SCIENCE during 1998-2008.	
Number of fractionalized papers (Frac P)	165.8
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	27.45
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.2
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	1.65
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	1.89
CPP normalized in relation to mean citation rate of the PLANT SCIENCE sub-field set (average=1,00).	
TOP 5% (TOP5%)	23.8
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch index per researcher (h-Index/PhD)	12.14
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	5.72
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	18.07
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher (HF-Index/PhD)	5.02
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.88
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	

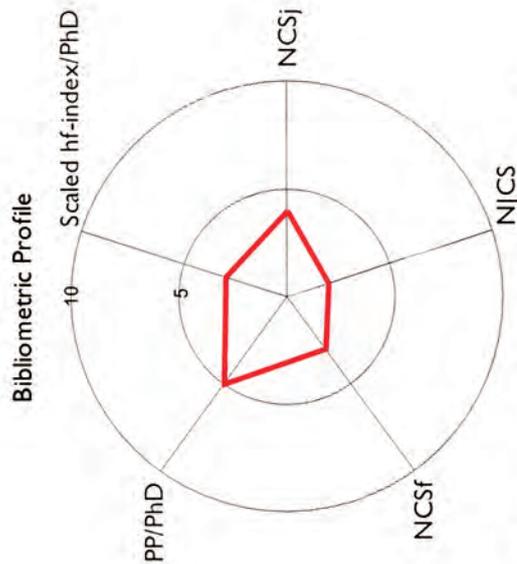


Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.

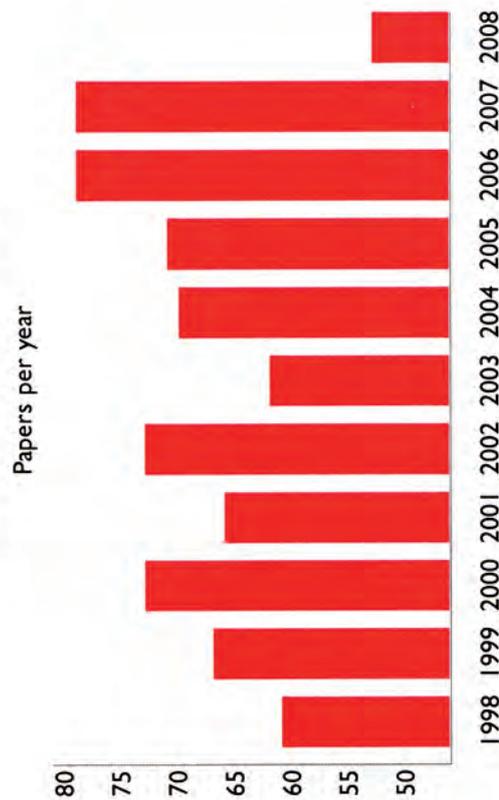


GENETICS AND BREEDING (14) - BIBLIOMETRIC INDICATORS

Number of papers (P)	743
Number of papers (articles, letters, proceedings papers, reviews) published by GENETICS AND BREEDING during 1998-2008.	
Number of fractionalized papers (Frac P)	260.3
Sum of author fractionalized papers during 1998-2008 ; fractions depending on number of authors per paper.	
Citations Per Paper (CPP)	12.23
Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.	
Journal Normalized Citation Score (NCSj)	1.08
CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).	
Normalized Journal Citation Score (NJCS)	0.96
Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.	
Field Normalized Citation Score (NCSf)	0.98
CPP normalized in relation to mean citation rate of the GENETICS AND BREEDING sub-field set (average=1,00).	
TOP 5% (TOP5%)	8.3
Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.	
Hirsch Index per researcher (h-Index/PhD)	6.56
The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.	
Fractionalized Hirsch Index per researcher (hf-Index/PhD)	3.2
The h-index, taking the number of authors on each paper into account.	
g-index per researcher (g-Index/PhD)	10.44
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g ² citations.	
Scaled hf-index per researcher(Hf-Index/PhD)	2.76
Normalization of the hf-index based on citation reference values per ISI fields.	
Publication Points per researcher (PP/PhD)	0.83
Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.	



Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.



CHEMISTRY, MOLECULAR BIOLOGY AND MICROBIOLOGY (15) - BIBLIOMETRIC INDICATORS

Number of papers (P) 799

Number of papers (articles, letters, proceedings papers, reviews) published by CHEMISTRY, MOLECULAR BIOLOGY AND MICROBIOLOGY during 1998-2008.

Number of fractionalized papers (Frac P) 267.4

Sum of author fractionalized papers during 1998-2008; fractions depending on number of authors per paper.

Citations Per Paper (CPP) 12.19

Average number of Citations Per Paper (as of December 31, 2008) calculated without first author self-citations.

Journal Normalized Citation Score (NCSj) 1.02

CPP normalized in relation to mean citation rate of the journals in which the unit has published (average=1,00).

Normalized Journal Citation Score (NJCS) 1.14

Impact of the journal set in relation to their respective sub-fields (average=1,00); subfields defined by Thomson Reuters.

Field Normalized Citation Score (NCSf) 1.1

CPP normalized in relation to mean citation rate of the CHEMISTRY, MOLECULAR BIOLOGY AND MICROBIOLOGY sub-field set (average=1,00).

TOP 5% (TOP5%) 9.1

Percentage of papers that have received more citations than the 95th citation percentile within their sub-field.

Hirsch index per researcher (h-Index/PhD) 8.07

The h-index is the h number of papers that have at least h number of citations. This indicator provides a combined index for productivity and recognition.

Fractionalized Hirsch Index per researcher (hf-Index/PhD) 3.81

The h-index, taking the number of authors on each paper into account.

g-index per researcher (g-Index/PhD) 12.63

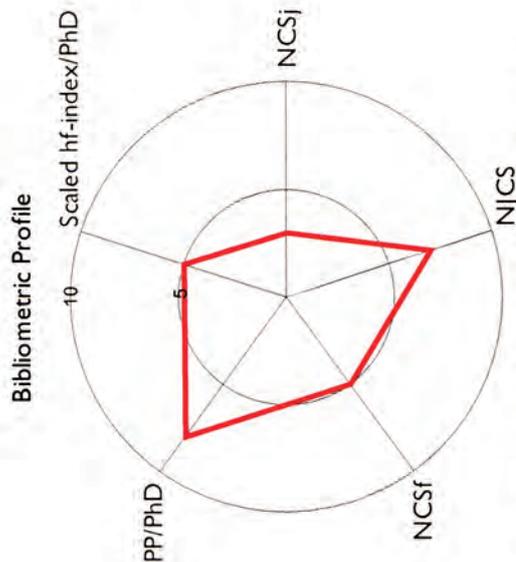
The g-index is the largest rank (papers arranged in decreasing citations order) such that the top g articles together received at least g² citations.

Scaled hf-index per researcher(Hf-Index/PhD) 3.5

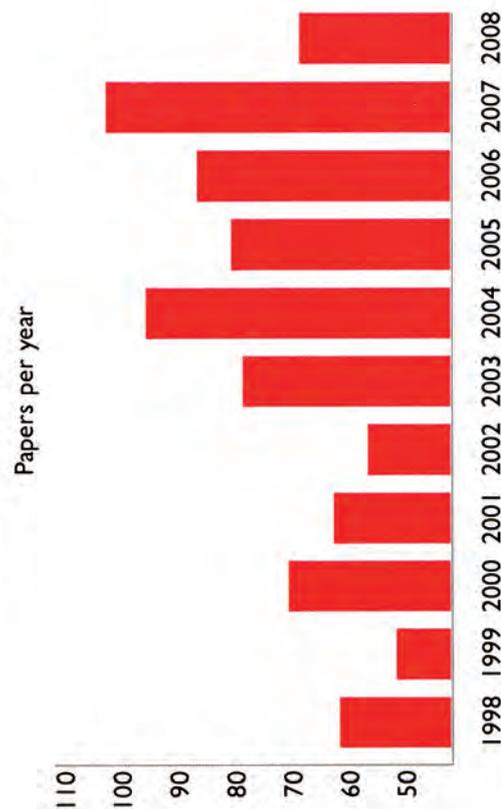
Normalization of the hf-index based on citation reference values per ISI fields.

Publication Points per researcher (PP/PhD) 1.05

Points are calculated on author fractionalized publications during 2004-2008. Different publication channels (books, chapters and journal articles) translates to different levels (1 or 2) with higher points given to high-profile journals and publishing companies.



Decentile rank within SLU on five indicators (10=high rank). Figure is further explained in the accompanying Report to Panels on Performance Indicators.



R 2

Reports from the Scientific panels on research fields and individual units

Reports from the Scientific panels on research fields and individual units

1	Economics and Statistics	23
2	Landscape Architecture, Urban and Rural Development	56
3	Ecology and Environmental Sciences	110
4	Food Science and Safety	147
5	Animal Health	163
6	Animal Husbandry	203
7	Biomedicine	237
8	Forest Management and Products	253
9	Biosystems Technology	296
10	Plant Protection	325
11	Plant Production	361
12	Soil and Aquatic Sciences	390
13	Plant Science	422
14	Genetics and Breeding	437
15	Chemistry, Molecular Biology and Microbiology	462

N.B.: Each Unit of Assessment was invited to comment on factual errors in the draft report before it was finalised. In the final version published here, the majority of the factual errors have been corrected. However, in a few instances errors may still remain.

Report – Part A: General Assessment of the Research Field

Panel 1. Economics and Statistics

We divided the Panel UoA's to four disciplines and comment them as follows below. UoA 510_1 on Agrarian History and Economic History we didn't have sufficient competence to fully evaluate.

1. Statistics (UoA's 300_1, 566_2 and 566_2)

Strength: Good competence, international networking, strong publication record

Potential: Wider promotion of statistical methods across SLU, particularly for FOMA

Infrastructure: Improved co-ordination of teaching and research activities in statistics, establishment of European centre for Biostochastics

Increased capacity recommended for following research areas: GIS, geoinformatics

2. Business (UoA's 231_3, 510_4 and 638_2)

Strength: Industry collaboration and impact

Potential: Junior staff that will contribute more to scientific research

Infrastructure: Integrate forces for larger projects, develop a strategic plan to balance scientific and applied research

Increased capacity recommended for following research areas: Supply chain analysis, consumer research, more quantitative analysis

3. Applied economics (UoA's 300_3 and 510_2)

Strength: High quality research and EU funding in Agricultural Economics

Potential: International co-operation at the graduate level, better utilization of synergies in Forest Economics

Infrastructure: -

Increased capacity recommended for following research areas: Analysis of carbon sequestration in forest management

4. Environmental & resource economics (295_3, 300_2 and 510_3)

Strength: High international recognition in science and national recognition among policy-makers

Potential: Deeper collaboration between units within SLU

Infrastructure: Establishment of the UMERÉ research centre in Umeå

Final note: From individual reports, scores of individual Units on scientific quality, recognition & leadership, relevance & impact and strategy & potential can be compared. If a Unit receives high score (5-6) on relevance & impact at the same with having a much lower score (2-4) in scientific quality, SLU might want to consider some supportive tools to enhance Unit's future potential. However, in some cases strategic planning and co-ordination of activities is needed before any improved performance in terms of scientific quality may be realized. Please also note that although many of our UoA's were of very high scientific quality, our grading on quality did not include grade 6 because we did not quite understand how to interpret what the grade 6 for "world leading" would mean - a Nobel price in Economics?

Part B: Report on individual Unit of Assessment

Panel 1. Economics and statistics

Unit of Assessment: 231_3 Forest Business Administration

B 1. General assessment of the Unit of Assessment

Unit based in Uppsala but organizationally within Faculty of Forest Sciences. Some resemblance to research activities in Forest Economics in Umeå, but here with a clear industry orientation and use of business administration methods (multivariate methods, qualitative case studies). The research within the unit appears fragmented. The scientific publications span from accounting information to consumer preferences for residential deck materials, workers' health to growing salix as an energy crop. Unit has a running Master programme with 20 students annually and received PhD student price for educational excellence twice in recent years. Close co-operation with firms, but fragmented industry structure in wood products sector inhibits obtaining more private financing.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The unit's publication performance is not very strong. One recent article in *Canadian Journal of Forest research*, other one in *Silva Fennica*. The number of scientific publications is relatively low and output unevenly distributed between researchers (where some are very active). Produced number of PhDs six over 1999-2008.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Based on the modest publication record, no leading role in the scientific debate. As a research environment Unit seems to function better.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

UoA's cooperation with industry is bilateral and effective, MIK project as an example. It is performed on expert level, and the impact on industry is substantial. The steering groups for research projects are functioning and include various industry representatives. This makes research well rooted in industry needs.

Steps have been taken to decrease the gap between industry needs and research results in customer perceptions. UoA's master course provides valuable education for future industry professionals. Web services in disseminating results to industries should be developed further.

Focus on forest industry in an international context. In the future the impact could be enhanced through globalization of industry and we expect them to continue actively in this arena.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

No clear strategy, but have developed and processes together research ideas. Professor retiring end of 2010. and new opening in Associate professor. Balanced gender situation. Synergies between different UoA's (in Department of Economics, Department of Forest Economics) should be utilized to capture full potential.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable.

B 4. Actions for development at the Unit of Assessment

One may ask whether it is a good idea to have an *industry* related unit that covers such a wide range of topics and academic disciplines. In order to conduct research on (say) consumer preferences regarding forestry products, one does not necessarily have to possess deep knowledge about forestry. Further co-operation with Economics and Statistic units at the Campus. Web-pages should be improved to communicate results to stakeholders. Faculty should take early initiative to plan replacement of retiring Faculty professors.

B 5. Additional information

The competence required lies within consumer economics, survey methods etc. Better methodological collaboration locally should be utilized promoting scientific competence.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1 Economics and Statistics

Unit of Assessment: 295_3 Natural Resource Economics

B 1. General assessment of the Unit of Assessment

This is a relatively new unit, which was established in 2001 at the Southern Swedish Forest Research Center. The research centers on questions of the multiple functions of a forest within a general environmental economics framework. The publication record is slightly above average. The group is looking a balance between basic/methodological and applied research. The group could take more advantage of its location in southern Sweden, especially in terms of FOMA. There is some collaboration with Landscape Architecture and environmental psychology.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The publication record includes field journals, such as the *Journal of Forest Economics*. The number of publications is moderate. The research is applied with some minor methodological innovations in non-market valuation methods.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Leif Mattson is a member of the Royal Swedish Academy of Forestry and Agriculture and other committees. There are no major other honors. The strategy of “openness” has resulted in a regional reputation.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

UoA's research is known outside academic community, particularly to local and national authorities. UoA is represented on expert level in a number of national governmental organizations. Potential relevance on society of the UoA's non-market valuation research is high both for decision-makers (local authorities, national statistics offices and economic research institutes) and industry. Willingness-to-pay investigations are of particular interest for authorities and industry since the latter are generally unable to conduct such studies themselves. More attempts should be taken by UoA for promoting its research outside academic community.

Their work could have major importance to southern Sweden.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

This UoA does not have a viable strategic plan. Their major goal is to become larger, but they are not specific about how they will attain that goal.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Mattias Boman is a member of the environmental monitoring and assessment committee of the Faculty of Forest Science at SLU. They are engaged in intertemporal collection of social values of environmental change. This activity has high relevance and impact and strategic potential.

B 4. Actions for development at the Unit of Assessment

We recommend that the unit engage in more government investigations, such as the predator policy, to take advantage of their location in southern Sweden. They should deepen their collaboration with landscape architecture. They should engage in more research activities to increase their funding base. They should increase their collaborations with colleagues in Copenhagen and Lund.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 300_1 Biostochastics

B 1. General assessment of the Unit of Assessment

The unit on Biostochastics is part of the Centre of Biostochastics which is a cooperation between the unit (located at Umea in the Department of Forest Economics, Faculty of Forestry) and the unit on Biometry located in Uppsala in the Department of Energy and Technology (Faculty of Natural resources and Agricultural Sciences).

The unit is one of the leading research units in Biostochastics in Europe, the research conducted in recent years has resulted in significant developments in the field, many of the projects have been multi- and interdisciplinary, in cooperation with other units at SLU. The research topics cover a wide range of topics, such as statistical estimation, spatial/temporal models, time series analysis, classification methods, Markov models, econometric models and image analysis.

The unit is involved with FOMA, esp. with respect to developing quality assessment methods and by providing statistical input in a variety of FOMA projects initiated by other units.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The unit shows a high degree of scientific quality, as indicated among others by the excellent publication record, both in absolute numbers, publications per scientist and the quality of journals (such as the leading statistical journal JASA and other high level scientific journals). The research projects have resulted in the advancement of statistical methods in the biological sciences. The unit collaborates with many other units in SLU, on the development and application of statistical methods, such as environmental monitoring, econometric models, growth models, remote sensing and others.

The unit is internationally recognized as one of the top research units in biostochastics, a number of co-operations exists with foreign research units (among others with China). Based on the biostochastic unit at SLU as core plans have been developed to create a European center for Biostochastics, which could soon become the leading research centre in the field.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The research projects of the unit in the field of biostatistics have a high level; they can be regarded as leading in the field. The research environment is very good, the collaboration with other research units is quite active, in addition Nordic Summer Schools have been organized by the unit in 2004 and 2008 for the advancement of statistical methods in the biological sciences. A large international network in the field does exist providing an active high level exchange among scientists.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

A number of joint projects with other disciplines have been conducted providing statistical input into a variety of areas, direct impact on practical issues have can be noted in the use of probabilistic classifiers developed by the unit by the County Administrative Boards and River Basin Authorities, indirect impacts can be expected through the common research projects addressing practical issues. The development of statistical models for environmental monitoring, the development of new classifiers in remote sensing, the development of new methodologies for large scale forest and ecological inventories have direct positive impact of societal issues (e.g. for the sustainable management of forests, climate change issues) and can also provide methods to be used by industrial research and provide also directly results useful for industrial applications.

The unit is well connected with research units nationally, within Europe and worldwide. For the Nordic countries summer schools in biostochastics have been conducted, a good network has been established.

Active collaboration exists with a large number of research units worldwide (within Europe and China), with the planned establishment of a European Centre for Biostochastics at SLU these contacts could be intensified and the unit could establish itself as leading centre in the field, for the development of biostatistical methods, joint research projects and the training of young scientists and PhD candidates.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The unit has excellent research potentials also in the future. There is a growing need for research on the development and application of statistical methods to biological problems, with the increasing complexity this demand can be expected to increase. The quality assurance of research and environmental assessment will have also in the future significance, it can be expected that this even will increase in the future.

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The application of statistical methods to complex biological systems requires a high degree of infrastructure and diversified research specialists – only a large unit could provide in the long range satisfactory results. As the problems w.r.t. complexity of the projects and insufficient resources are the same in many countries the plans for the establishment of the European Centre for Biostochastics at SLU seem to be an excellent solution, this would provide a network of European universities with biometric or biostatistics expertise in agriculture and forestry for the development of joint research projects (e.g. funded by EU), exchange of expertise and the development of joint PhD programs and training courses.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

The unit is active in FOMA by developing quality assessment methods on a statistical basis. In addition input into FOMA activities are seen in a variety of joint projects by various collaborations, such as the Department of Aquatic Science and Assessment, Department of Wildlife, Fish, and Environmental Studies, the Department of Forest Ecology and Management (all SLU)

B 4. Actions for development at the Unit of Assessment

The research is already at a very high level, however for the long term development the staffing should be increased, at least 1 additional permanent senior position should be created. The recruitment of PhD students should be intensified, leading to a higher number of doctorates- mathematicians, statisticians, and applied biometricians (from agriculture, biology, forestry) should be recruited to provide a strong unit ranging from theoretically oriented to more application oriented candidates. This widening of the scope of PhD candidates could also solve the problem of not being able to attract a sufficient number of qualified PhD candidates – the necessary expertise of the candidates depends on the projects and problems at hand. This widening of scope also could lead to a higher degree of acceptance of statistical research (on a more applied level) by more departments and individual researchers at SLU.

The international links could be best strengthened by the establishment of the European Centre of Biostochastics in Umea.

B 5. Additional information

The unit for biostochastics (Umea) has established a cooperation since a number of years with the unit on biometry (Uppsala) through the Centre of Biostochastics, a number of excellent research cooperations has resulted for joint research and teaching on the PhD level. Cooperation with the unit of Applied Statistics is not as well developed, in one research projects 2 staff member from that unit are included in a project – this cooperation should be intensified for the better coordination of statistical research and teaching program at SLU.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

In the long range it should be considered to integrate statistical teaching on all levels at SLU, ranging from undergraduate, graduate to doctoral level, research activities in statistics and modelling, and statistical consulting at SLU into one organizational unit or in closely related units. However it should be kept in mind, that statistical expertise has to be available at all campus locations of SLU, especially in Umea, Uppsala, Skara, and Alnarp.

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 300_2 Resource and Environmental Economics

B 1. General assessment of the Unit of Assessment

This unit has a strong emphasis on the interaction between humans and the environment drawing from many fields in economics (non-market valuation, general equilibrium) and complementary fields such as statistics, forestry, and climate science. There is a great deal of potential for FOMA activities, but they have not yet received funding to pursue them. They are working to establish their unit as the major collaborator in the region for both the public and private sectors. The intellectual environment has been enhanced with efforts to bring in top researchers to visit. These relationships have developed into co-authored journal articles.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The publication record includes an article in the *European Economic Review*, a top general economics journal and several top field journals, such as the *Land Economics*. The number of publications is good but could improve given the number of researchers and their low teaching expectations. The research is applied with some minor methodological innovations.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Researchers in the group have a broad international network. They have been recognized with honors and awards and have been appointed to positions on commissions and councils. Researchers in the group are used extensively as national and international experts within the field.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The UoA's research within management of natural resources is highly relevant both for decision makers and industries. They have a great deal of outreach activities. The UoA is present on expert level in various governmental organizations. There are numerous examples, e.g. one member is on the Sustainability Commission. Potential and in some cases actual impact of UoA's research is substantial. Willingness-to-pay studies are highly relevant for industries and authorities alike. No bilateral collaborations with industry but research results are distributed through seminars at branch organizations.

They are working to develop collaboration with local and regional stakeholders.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

This UoA has a strategic plan and is following it. The goals are ambitious, basically to be one of the centers of research in environmental economics in Europe. They have strategies to reach their goals. They only have one woman who is a post doctoral researcher. They have shown an impressive willingness and ability to collaborate with other units and to build and develop a formal *Centre* within their own university, regionally, nationally, and internationally.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

They have conducted some research on environmental monitoring and assessment, but this is not a major thrust at this point. They argue that they are well positioned to provide extensive services in FOMA.

B 4. Actions for development at the Unit of Assessment

They should pursue FOMA activities that take advantage of their location in northern Sweden. They should recruit female additional researchers. The UoA should increase collaborations with UoA 300_3 Forest Economics at Umeå.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 300_3 Forest Economics

B 1. General assessment of the Unit of Assessment

The UoA is based in Umeå and hosts a staff of three professors (PI 1, PI 2 and PI 3 - the first one financed by the Faculty and the other 2 promoted?), two lecturers and 2 PhD students within the Department of Forest Economics. Unit research profile can be characterised focusing on the development of methods for decision making in forestry, analysis of forest policy, studies of the bio-energy sector, and a locally relevant topic of co-management of forests and reindeer husbandry.

NOTE: The Self-Assessment template was filled by PI 1 whereas PI 3 and PI 2 participated in the interview. PI 3 provided account of activities by some of the staff members, PI 2 spoke for himself only, and overall we did not receive a full and clear account of the Unit. Particularly the state of strategic planning of activities, or existing co-operation internally or externally remained very confusing. There was a great discrepancy between information provided by PI 1 and what was indicated especially by PI 2 in the interview. PI 2 claimed that the whole Unit was created artificially for the purposes of this evaluation only, and that he and PI 1 have not communicated at all during the last 20 years. PI 2 also claimed that his publications and supervised Dissertations had been intentionally left out of Unit report and he provided several supplements (however, in the self-assessment 2 out of 5 key publications named by the Unit were by PI 2 and his co-authors). Information on PI 2's large multinational research project plan which he presented in the meeting could not be verified from other sources, and so it had to be considered to exist at an early planning stage on his side only.

Based on this diverse set of information, the level of cohesion within the Unit seems to be extremely low and there could be substantial organizational problems in the Unit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Main research themes and methods seem to follow traditional themes and approaches in the field of forest economics already present in the early 1980s. Number of PhD degrees over 1998-2008 is in total four, which is of moderate level considering 3 professors (although it remained unclear whether PI 1 had taken a substantial leave absence because of political involvement at EU level). Publication performance of this Unit shows moderate overall performance, although economically oriented Units are not easily comparable with natural science oriented Units. However, the total output is very unevenly distributed between the staff members; PI 3 appears to be the only senior researcher producing a steady annual outflow of publications in the peer review forestry journals. He has also ongoing co-operation

with other Units and University Department. PI 3 has externally financed research projects (by Mistra, FORMAS), whereas other external financing at UoA mainly originates from (Forest?) Industry. Recently publications also include themes related to co-management of forests and reindeers based on the work by the 2 PhD students.

Based on diverse information from interviews and Self assesment it not possible to comment at the Unit level on the quality of scientific networks or on the collaborations regarding the whole Unit.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

No strong evidence on leadership of scientific debate despite forest policy being one of key research themes. No signs of external academic recognition (e.g. assignments as external examiner), no interaction with society (except PI 1 as Member of EU parliament, which however cannot be counted as a SLU activity?). Some activities regarding PhD education exist.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

UoA has close industry ties, actively participates in public debates, also on international level. Projects initiated by the unit are ambitious but seem to lack any strategic planning. It is hard to evaluate to which extent UoA lives up to its declared goals. The scientific output is moderate and therefore its relevance for society can not be adequately assessed. Active participation in public debates has an impact on society, but without a solid scientific ground, this impact is not necessarily positive.

Some emphasis on local issues, as an example interaction between forestry and reindeer husbandry.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

A confusing situation in the Unit reflects lack of strategic planning and leadership, which should not only be a problem of this Unit but also a problem of the Department. Currently existing opening for Assistant Professor in Forest Policy could possibly renew the Unit in the

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

future? Some senior staff members also approach retirement within 5 years. Two PhD students are female, balancing the otherwise uneven gender distribution of the Unit.

Synergies not fully exploited between other Units at SLU, even within the same department. There is a need to take the unfunctionality problem of the Unit into consideration to reach full potential.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Two pilot studies generated for 2009-2010 regarding, first, gathering annual information on recreational value of forest resource and, second, CBA of ash recycling. Small scale projects with some potential interest and relevance since economic dimension within FOMA has been so far neglected at SLU.

B 4. Actions for development at the Unit of Assessment

People in the Unit should build a common mission and generate a plan for future development. Maybe some organizational changes are eventually needed since the difficult working atmosphere seems to be a long standing situation. It could be also discussed whether this Unit and the neighboring Resource and Environmental Unit within the same Department of Forest Economics could be organizationally integrated to build a more healthy and coherent working unit? Both Units also seem to address research topics related to Forest Policy, and a new recruitment (Assistant Professor) is on a way in this Area. Also some senior staff members approach retirement, which provides scope for reorganization.

B 5. Additional information

NOTE: This assessment is mainly based on information available in the Unit's Self Assessment report and publications listed as basis for Bibliometric analyses. As far as we could see the supplemented publication lists of PI 2 did indicate two new peer reviewed articles, which had been dismissed from Unit's Bibliometric analysis (but had been listed among the top 5 publications of the Unit). The number of popular science publications was high, but their impact is difficult to estimate.

Overall it was very difficult to find out in the interview situation what the real working situation in this Unit is, but there are symptoms that it is quite difficult since the senior researchers lack mutual trust (how is the situation for example is being reflected from the point of view of the 2 PhD students could not be discussed at all). Probably the situation cannot be solved without external interference from the side of SLU.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 510_1 Agrarian History and Economic History

B 1. General assessment of the Unit of Assessment

The UoA is located in Uppsala, started their research activities in 1994 and is part of the Department of Economics since 2001. The UoA encompasses around 10 persons, 40% of the time is used for teaching. Research projects include history of animal husbandry, landscape history and garden history. The UoA is unique in Sweden.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The bibliometric analysis of this UoA is not usable, because the indicator shows 0 papers. Nevertheless the publication list and the new table of the total number of publications per UoA we got, indicates a few peer-reviewed scientific papers and a high number of book chapters. Also the number of PhD Theses is high related to the size of the UoA. But due to the fact that none of the panel members is an expert in history-research we are not in the position to evaluate the scientific quality. We recommend in this case that the university should ask an external expert to review the scientific work of this unit.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

As already mentioned the panel has no deep knowledge on history-science, so we are not in the position to value the UoA's ability to lead the scientific debate in this field. Nevertheless we have the impression that the UoA has a wide network in Europe and North America, well documented in the Self-Assessment.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

Educational and enlightening impact of UoA's research on the Swedish society at large is important. The UoA published a number of very popular monographs which may have an impact on the general society and also may have an impact on the recognition of SLU in the broader general society. UoA's research can be relevant for industry in some special cases: valuating and guiding third-world agricultural policies, special risk assessment taken from a historical perspective and applied on a national level. Historical studies are important in long perspective. To be attractive for industry, short-term forecasting should also be prioritized.

Most of the research is focused on Sweden.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA pointed out a number of relevant future projects, but it is not always clear how these projects are related to each other. In some projects it seems worthwhile to cooperate with other units across SLU. A clear strategic and coherent plan is missing.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable.

B 4. Actions for development at the Unit of Assessment

Publications in international peer review journals should be prioritized.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 510_2 Agricultural Economics

B 1. General assessment of the Unit of Assessment

The research of this unit encompasses a broad range of different topics and research methods. For example econometric methods are employed to study agricultural-, resources and environmental related problems, Members of the Unit also work on methodological issues concerning choice experiments as well as on topics concerning the food supply chain and food marketing.

There are a number of publications in high ranged field journals like the “American Journal of Agricultural Economics” or the “European Review of Agricultural Economics”. Nevertheless the number of publications could be higher in relation to the size of the unit and the number of PhD-students over the last 10 years is not very high. Members of the unit argue that it is sometimes difficult to recruit competent students with an agricultural background for research positions.

In addition the unit has excellent contacts to the scientific community as well as to stakeholders on national and international level, which results in a high external funding ratio (around 60%).

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

All members of the unit are active in research and as already mentioned they are publishing in high ranged scientific journals. The research efforts focus on “subject matter research” as well as on “disciplinary research”. Sometimes one might have the impression that it would be better to concentrate the research agenda on a smaller scope. One of arguments against this is, that the UoA does not represent a formal administrative unit, but was only formed for the ongoing evaluation process and every researcher has the right to follow his ideas. Another argument is, that the group has to cover a wide range of economic topics in teaching, and therefore it is worthwhile to conduct also research on these issues. Nevertheless it should be possible to increase the number of publications in the future.

On the basis of this evaluation, award a score from 1-6 ¹:

4

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA as a whole is well known in the scientific community and has an extensive international network with contacts in Europe and North America as well as ISI, New Delhi. Based on this network and their scientific reputation, they play an active role as Coordinator in forming research-groups in order to apply for EU- funding. But they are also asked to joint as partner in major national and international scientific collaborations. These activities result in a high amount of external funding.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA reports that they have an excellent network through former students to the industry. This is of high importance for developing new and relevant research ideas. This contacts also help to conduct empirical oriented research. Empirical master/undergraduate theses have often been completed in collaboration with industrial partners. In addition member of the UoA give speeches and participate in seminars for the industry and also public and governmental stakeholders. Request for collaborations are often initiated from outside and the UoA reports that they sometimes are not able to respond to these request due to limited capacities

The empirical research and “problem solving” activities are mainly conducted on a national level, but they are also part of a project funded by SIDA concerning capacity building in Macedonia and they have an active collaboration with Haramaya University in Ethiopia.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Analysing the implications of food and domestic agricultural policies will be continued. The integration of former SLI activities is increasing the ability to conduct applied policy analyses for governmental and public stakeholders in shorter time.

In addition the UoA plans to focus more on food marketing issues. Another topic is to expand the interdisciplinary research within SLU.

In order to solve the recruitment problem of PhD students, the UoA plans to collaborate with other Nordic Universities and to provide something like a “virtual graduate school”.

Looking on the performance record of the group in the past, it is very reasonable that they might reach their goals. Nevertheless one might get the impression that this is not a “strategic plan”. This might be due to the fact, that the UoA is not a formal group and members of the group are following their own individual scientific interests.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

At the moment this UoA has no FOMA activities, but may contribute if FOMA will focus more on economic issues.

B 4. Actions for development at the Unit of Assessment

To make it easier to formulate a common strategy for this UoA it might be useful to transfer this UoA to a more formal group. It could be that the recognition of such a formal group might be higher and would also attract students from other universities across Europe.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 510_3 Environmental and Natural Resource Economics

B 1. General assessment of the Unit of Assessment

This is a strong research group with policy contributions. They have a substantial group of doctoral students relative to the size of their group, but they need to build a more consistent level of funding. Their research focus has shifted twice over the period studied, based on staff turnover. They are planning to increase capacity and interdisciplinary collaboration in bioenergy as a funding strategy. Their expertise is different from other units, and they are well positioned to provide analysis for climate change policy and sustainability. They currently cooperate across many disciplines relevant to the environment and natural resources, including mathematics, ecology, hydrology and natural scientists in biodiversity management.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

A key focus of the research is theoretical macroeconomic-environmental policy. This differentiates them from other environmental economics units. They want to build capacity in econometrics, which will complement their current thrust. Their publication record is notable with many top field journals, especially in the *Journal of Environmental Economics and Management*. In the past, this group has published in the *American Economic Review*. Their academic network is already well established, but they are working to increase the scope of this network mainly through seminars.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Two members of this group are recognized as leaders in the scientific debate. Ing-Marie Gren is on the editorial council of *Environmental and Resource Economics*. Gren provides service in the evaluation and assessments in Scandinavian and Canadian universities. Hart is on the editorial council of the *Journal of Environmental Economics and Management*.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The UoA's has produced reports for the Swedish EPA and Board of Agriculture that are influential in marine policy. UoA's empirical research is known outside academic community, mainly to public authorities. UoA is well represented on expert level in policy debates at governmental bodies and public organizations. More effort should be put into making UoA's research known to decision-makers. Environmental policy scenario analysis tools should be developed and distributed to relevant authorities.

There is a regional research focus on the Baltic Sea and Swedish environmental regulations. UoA research results can have a long-term impact on a national level.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

There is a strategic direction in this UoA, mainly to become widely recognized as a leading research unit within environmental and resource economics within Scandinavia and beyond. They are planning to do this through increased participation in conferences and collaborations and networks. They are also trying to increase their external funding and recruitment of students.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

No FOMA activities are listed.

B 4. Actions for development at the Unit of Assessment

The UoA should make efforts to increase external funding. The UoA seems well positioned to participate in FOMA activities in the assessment of environmental policies. Collaborations and/or capacity building with applied econometricians could increase this group's productivity and impact. The UoA should take advantage of their specialized expertise in marine economics to increase their external funding base.

B 5. Additional information

The UoA has shown interest in FOMA activities with a previous proposal, which was declined. Gren participated in a workshop that was geared to integrating economic analysis in environmental monitoring and assessment activities.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 510_4 Agribusiness and Rural Development

B 1. General assessment of the Unit of Assessment

In the Self-Assessment the UoA points out that there is no formal unit of “Agribusiness and Rural Development” within the Department of Economics. Therefore no mission can be specified for the unit, each person is specialized and the collaboration between the UoA members is limited. The UoA’s research focuses on farm management, rural entrepreneurship, small business finance, food marketing and agricultural co-operatives. No strategies or potentials are formulated in the Self-Assessment. Prof. Jerker Nilsson, Richard Ferguson and Helena Hansson represented the UoA at the panel meeting. All three argued that they have a very high teaching load and therefore only very limited time research. Only a few papers are published in leading journals and the number of PhD students over the last 10 years is very low, taking into account that the UoA has 3 Professors.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Recently conducted research projects were focused on management aspects on dairy farms and on product-development regarding functional food. These research activities are mainly carried out by younger researchers. Therefore also publication activities in international journals are unevenly distributed among group members. On average the scientific quality of the UoA is inadequate (2). But nevertheless there are some exceptions, for example Helena Hansson got the “Wallander scholarship from Handelsbanken” for her PhD thesis.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Due to the low number of publications in international field journals and limited research activities in recent years, the contribution of the UoA as a whole to the scientific debate in its field is limited.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

One common objective of all three professors of this UoA seems to be to support the agricultural industry in Sweden. One of the major activities for example is “Agriwise”. The “Agriwise” database provides actual information for farm production planning for the different regions of Sweden and is widely used by farmers, extension agencies, banks etc. In order to update the database regular meetings with stakeholders are organized.

Another example is reports, articles in farmer magazines and books published by Jerker Nilsson dealing with farmer co-operative issues.

UoA is proactive in searching contacts outside the academic world. UoA has experience in successful bilateral cooperation with industry. These kinds of activities should be maintained and further developed. For example, a follow-up of impact of SLF-funded project on dairy farms efficiency is strongly recommended

The applied research activities of the UoA are mainly restricted on Sweden and Scandinavian.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

What the panel learned from the UoA was rather disappointing. In the Self-Assessment the UoA does not provide any ideas what goals and strategies might be worthwhile to follow in the future. Pointing to the facts that the UoA is not an administrative unit and all three professors will retire in the near future goals and strategies for the UoA have never been stated or even discussed between the UoA members.

During the interview the younger researchers pointed out some fragmented research topics but there was not a consistent picture or vision how to develop the UoA in the future. At the moment it seems that this UoA is without any leadership and it seems urgent that the Department Head takes action to ensure that the younger researches have a long term perspective and incentives to pick up new research activities. Therefore it might be necessary to reduce the teaching load.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

No activities in FOMA.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

We recommend that the Department takes action to develop a strategic plan for the UoA together with the younger researchers because we do not have the impression that the UoA is able to do this by themselves. One idea may be to use the “food chain management” approach as a focus for the UoA and group the different ongoing research activities in this UoA around this approach. This might provide the opportunity to integrate research on farm- and business management, research on small scale food processors, address topics like coordination and cooperation in value chains as well as agricultural marketing issues. In addition, this process might also open the discussion about what topics should be covered when the department has the possibility to recruit new researchers and professors. There might also be opportunities to interact with the Department of Food Science to conduct research along the whole food supply chain and expand SLU's research activities on the food processing industry.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 565_2 Biometry and Systems Analysis

B 1. General assessment of the Unit of Assessment

The unit of Biometry and Systems Analysis is part of the Department of Energy and Technology in the Faculty of Natural Resources and Agricultural Sciences. There is cooperation with the Unit of Biostochastics in the Department of Forest Economics through the Centre of Biostochastics. The unit is working on an excellent level in the areas of mathematical statistics, bio-systems analysis, environmetrics, and geo-informatics. The unit has a good track record in the application of statistical and mathematical methods to a large number of problems, as indicated by the excellent publication record. The number of publications total and on a per researcher basis is highest of all units in the panel. The journals in which the papers are published are well recognized.

No FOMA activities exist at present, but there is a high potential for statistical/modeling input into FOMA with separate projects and joint projects with other units.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific quality of the unit is very high, the methods used/developed are of high standard. The publication record is excellent, both in absolute numbers and publications per scientist, the journals are of high standard. The research conducted resulted in significant progress in biostatistics, many of the articles demonstrate major methodological advances with a high degree of theoretical developments. The research of the unit is at the interface of mathematics/statistics with application fields, mainly, but not exclusively, agriculture and provides an important link of the highly theoretical developments to practical applications. The unit is recognized internationally, the international network is extensive and of high quality, most of the more theoretical projects are in collaboration with leading scientists in a number of different countries. Cooperation within Sweden is also given, on an informal level with a number of statistical/mathematical institutes at various universities and on a formal level with the unit of Biostochastics at Umea (in the framework of the Biostochasticum).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The research projects of the unit in the field of biometry have a high level; they can be regarded as leading in the field. The research environment is very good, the collaboration with other research units internationally and nationally (through the Centre of Biostochastics) is quite active. On a regional level programs for PhD students have been jointly organized with a number of universities in the region. The unit has a high international recognition, many scientists and doctoral students visit the unit at SLU, on the other hand members of the units are frequently invited to conferences or have been visiting scientists abroad.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Impact of UoA's qualified statistical research on other academic areas is significant. Some efforts are taken to reach outside the academic world and provide expertise for authorities on environmental assessment. The unit has been short listed on an environmental inspection program by EPA (1 of 4).

More cooperation with other units should be established in order to bring about the full potential and impact of such expertises.

The networking on the regional/national level is quite good, contacts to the statistical units in the universities in Sweden have been established, partly PhD-dissertation are directed jointly, courses for PhD candidates have been organized.

The networking on the international level is excellent, contacts exist to leading scientists in many countries, the international activities are numerous, the number of invitations as speaker internationally is very high.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future research potential is very high, statistical and modelling approaches are important for a variety of research studies, such as in long term ecological research and monitoring studies. This potential is true for independent research studies and for joint projects with other units. The strategic idea of the unit is to link data collected with research objectives by modelling approaches. This potential will be even more relevant in the future with an increasing complexity.

Younger faculty are recruited to the unit, but due to qualification requirements their number is limited.

Cooperation with other units at SLU is realized partially; there more cooperation projects would seem to be desirable and possible.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

FOMA activities do not play a major role in the activities of the unit at present. The potential of biostatistics and modelling in FOMA activities are high, both in form of direct methodological input and through joint research projects with other units. Plans do exist to increase FOMA activities as funding opportunities will develop in this area.

B 4. Actions for development at the Unit of Assessment

The research is already at a very high level, however for the long term development the staffing should be increased, at least 1 additional permanent senior position should be created. More emphasis should be put on joint research projects with other units at SLU, the unit can contribute to many projects in design, data acquisition, modelling and data analysis.

Similarly, the recruitment of PhD students should be intensified, leading to a higher number of doctorates in biometry. For this not only mathematicians or theoretical statistician should be considered, but also quantitatively oriented agriculturists, biologists etc. This would alleviate the stated shortage of qualified PhD candidates and also could help in achieving a higher acceptance of statistical/modelling research (both on a theoretical and more applied level) by more departments and individual researchers at SLU.

B 5. Additional information

The unit for biometry at Uppsala has established a cooperation since a number of years with the unit on biostochastics (Umea) through the Centre of Biostochastics, a number of excellent research cooperations has resulted for joint research and teaching on the PhD level. Cooperation with the unit of Applied Statistics at SLU is not as well developed.

In the long range it should be considered to integrate statistical teaching on all levels at SLU, ranging from undergraduate, graduate to doctoral level, research activities in statistics and modelling, and statistical consulting at SLU into one unit or in closely related units. However it should be kept in mind, that statistical expertise has to be available at all campus locations of SLU, especially in Umea, Uppsala, Skara, and Alnarp.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 1. Economics and statistics

Unit of Assessment: 566_1 Applied statistics

B 1. General assessment of the Unit of Assessment

The unit has been involved during the last years mainly with teaching and statistical consulting; little original research activities have taken place. Due to several reorganizations during the last years and due to financial problems related to budget deficits the research conducted was mainly related to problems that were encountered during statistical consulting. A unit on applied statistic is considered essential for an active and high level research and teaching program, statistical consulting has been conducted for a large number of projects, it would be desirable to increase also research on applied statistical methods – but in the past the resources available were not adequate to do so.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The statistical consulting aspects have been emphasized in recent years – important for the overall quality of a research program on the university level. The research of the unit conducted was driven by the requirements of the consultancies – the cooperation with other units on the campus have been quite good and successful, but little emphasis has been put on self initiated research on statistical methods, which would seem to be desirable for the university in the long run.

It is considered important to provide teaching programs and statistical consulting at all geographic locations of SLU, but at present the unit is not staffed at a sufficient level to provide this.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The contribution of the unit to the overall research at SLU is considered crucial, as statistical methods are basic to conducting scientific studies. The basic teaching of statistical methods has to be provided at the undergraduate and graduate levels; in addition PhD courses should be offered. Statistical consulting is important for most research projects, in addition the unit should do independent applied research pro-actively in statistical methods – in the past this has been

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only partially possible due the conditions described above.

The unit should be staffed and financed at a level that it can fulfil the requirements specified – this is considered essential for an attractive and leading research program.

Coordination with other unit dealing with statistics is considered essential to provide a cost effective approach, here especially the cooperation with the biometry unit and the centre for biostochastics are especially important; with the last unit cooperation on a project basis is already planned.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The unit has high relevance for research in agriculture on the SLU campus, in addition statistical consulting services are provided for Uppsala University, especially for the faculty of medicine (which seems to be more initiated on a personal basis of the present professor and not due to institutional agreements). Little independent research is conducted due to the limitations – more self initiated research on the development and application of statistical methods such as experimental design and analysis are desirable and necessary in the long run.

Excellent contacts exist on the local level in Uppsala, on the national level contacts do exist in statistics, on a regional level the contacts to the Baltic countries are especially worth mentioning – further international contacts are rather limited (which may be due to the organizational and financial problems specified above)

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The potential contribution of the unit to a high level teaching and research program at SLU is considered crucial. Coordination of activities with other units dealing with statistics esp. Biometry and the Centre of Biostochastics is necessary to avoid duplications. For the unit a reduction of the teaching load esp. on the undergraduate level is seemed to be necessary to attract high level statisticians to the unit after the retirements of the professor in charge of the unit today.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

FOMA activities are rather limited at present due to the restrictions in staffing and the heavy teaching load.

B 4. Actions for development at the Unit of Assessment

Major research activities of the unit are only possible if the teaching load is reduced and/or the staffing level increased. Coordination of teaching, research and consulting activities with the unit of Biometry on the Uppsala campus is considered crucial for the development of strong units on statistics. In the longer run an organisational merging of the two units should be achieved.

B 5. Additional information

The teaching load of the unit is very high for the staffing level – staffing should be increased to allow for more research activities. Cooperation with the other unit on campus that deals with statistical issues –Biometry- should be intensified. In the long run it is desirable to combine the two separate units to create a strong statistics unit for teaching at all levels, research and statistical consulting for the entire campus.

Part B: Report on individual Unit of Assessment

Panel 1. Economics and Statistics

Unit of Assessment: 638_2 Business Economics

B 1. General assessment of the Unit of Assessment

The UoA is located in Alnarp, consists of 6,5 FTE and has a high teaching load requiring 50% of the work time, due to the fact that it is the only economic oriented Unit in Alnarp. Lena Ekelund is just recently appointed to the Chair of “Horticultural Economics”. Over the last 10 years no PhD student worked in the UoA. This changed just recently, in 2008 two PhD students started their research work and in 2009 another two students are expected to join this unit. According to the information that we have received, only one peer-reviewed scientific publication has come out of this unit the last 10 years. This might be in partial due to the staff situation over the last 10 years.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The publication list summarizing the research activities of the UoA over the last couple of years is short which may be due to the high teaching load and the staff situation in the past. There is only one reviewed paper, so the scientific productivity in the past was low. Nevertheless there were a number of case studies often carried out in collaboration with industrial partners and therefore very much on the applied side of research.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit is only visible in its specialized field of horticultural economics but did not publish outside this field. Due to the good reputation in horticultural economics the UoA is member in the “Asia Link project”, coordinated by the Humboldt University Berlin and financed by the EU.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

UoA has regular contacts with food producers and retailers. Based on a number of applied case studies, partly carried out in collaboration with industrial partners and presented on several occasions, the UoA is proactive in proposing and getting acceptance for new studies. UoA's results are relevant for industry. Feedback on how research results have been used by industry is however lacking. Impact is therefore not possible to assess.

In addition to this, one person of the unit is member of the advisory board of the Swedish Inst. of food economics and member of the Market Board of Horticultural Products. Also the UoA is partner in the Consumer food research network, which is now financed by the private industry.

The empirical projects are mainly restricted to the southern part of Sweden.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA's goal is to tackle issues emerging along the supply chain. Due to the size of the UoA, the main focus will be on marketing and consumer issues, which might also have an influence on strategic planning of the firms. The UoA pointed out a number of relevant future prospects, but these prospects are vague and fragmented. The goals are not specified in sufficient detail and do not fit together to form a coherent research agenda. In addition it is not clear what strategy the UoA will follow to match the goals and how the research should be conducted.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

No activities.

B 4. Actions for development at the Unit of Assessment

The UoA should try to set up a coherent research agenda and to develop a strategy how to achieve these research goals. Due to the fact that in the past the research activities of the UoA were mainly focused on applied issues, the UoA should try to find a better balance between "subject matter" and "disciplinary" research. This also includes to clarify which international scientific journals may be suitable for publications as well as to reconsider how to conduct the

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⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

research projects, done by PhD students.

Since this is the only business-oriented UoA in Alnarp, it is essential for them to collaborate with Lund University and also Danish research groups, for example the MAPP-Centre at the Aarhus School of Business.

B 5. Additional information

Report – Part A: General Assessment of the Research Field

Panel 2. Landscape Architecture, Urban and Rural Development

This panel reviewed fourteen units of assessment in four departments, together with one research centre. Four units were from the Department of Landscape Architecture at Alnarp, five in Urban and Rural Development at Ultuna, three in Work Science, Business Economics and Environmental Psychology at Alnarp, one in the Department of Forest Management at Umeå and one in the Centre for Sustainable Agriculture also at Ultuna. The subject areas covered are highly diverse but also, taken together, quite distinctive in SLU. They focus on the varied relationships between society and the environment, perhaps also conceived of in some units as the relationship between people, space and place. There is also an important temporal dimension, with research embracing change and transformation over the spectrum from past to present and future. The units are characterised by research in a great diversity of disciplines, but are focussed particularly in the humanities and the social sciences. They involve a wide range of research methodologies and many different forms of engagement with stakeholders and the wider society. There is evidence of interdisciplinarity and internationalisation of research, but also an apparently fragmented approach, with a great range of size and different levels of focus and competencies in the research units.

The panel wishes to draw the University's attention to some particularly important characteristics of many of the units we have evaluated. Firstly, the social sciences and humanities approaches to research are very different to the methods employed in the natural and physical sciences. Researchers in these areas often feel marginalised within a University with a strong natural science tradition. There needs to be greater institutional understanding of and support for these different traditions. There are considerable opportunities to create interdisciplinary links between the natural and social sciences and the humanities.

The distinctive nature of the social sciences and the humanities is reflected in very different perspectives on publication outlets. Although peer refereed journal papers are universally recognized as important, in certain areas great weight is also attached to dissertations, monographs, books and book chapters, advisory reports and, especially in design disciplines, non print media, including designs, competition entries and awards, installations and performance. Excellent quality can, in theory, be found in all types of output. In terms of journals, there are relatively few outlets in some research areas and some of these do not feature in the databases and citation indices that are used to construct bibliometrics. We were constantly advised by those presenting on behalf of the units that the publication lists included in the evaluation packages were incorrect, in part for this reason. The bibliometric analyses did not capture all the important contributions of these small units and were not especially helpful to our panel. We have taken this into account in our rankings.

The other important characteristic of many of these units is the virtuous triangle linking research, learning and teaching, and professional practice/knowledge exchange. It is clear that many of the academics have heavy teaching loads and find it difficult to devote sufficient time to research.

We offer our findings and recommendations in two distinct areas of research excellence and potential: landscape architecture and urban and rural development.

Urban and rural development¹

The university reorganization in 2006 created the Urban and Rural Development Department at Ultuna. This facilitated the emergence and establishment of units employing social science approaches to address complex, often contentious development issues in developing countries as well as in Europe. These methods are particularly suited to addressing the nature-social-cultural interface that has been demonstrated to be of critical importance in producing and implementing sustainable management programmes. They complement more traditional natural science research approaches and provide rich insight into the core of many environmental challenges today. The department has created important research centres, research schools and graduate degree programs that are appealing to a growing number of students from all over the world. Multiple benefits of this evolution have already been demonstrated, for example, in addressing forestry and water management issues. With these benefits, however, come challenges that are evident and must be addressed in order for the institution to realize the world-class distinction that is possible.

Robust research on sustainable food and farming is fundamental for future food production, environmental stewardship and the development of agri-environmental policy. SLU has the capacity to lead nationally and internationally in this area due to the blend of natural and social science expertise available together with real links to stakeholders in the food and farming industry. At present research is carried out within the Agroecology unit and also the Sustainable Food Systems unit (CUL) as well as in other disciplinary departments, which the panel has not seen. Within this core grouping there is already some internationally recognized research but the panel feels that the subject would benefit from more support from SLU in the form of a professor in agroecology. Further development in this area requires this grouping to achieve both critical mass and greater focus. One model would be to bring all the research on sustainable food and farming systems into an expanded agroecology grouping and to separate out the knowledge transfer and exchange remit into a revitalised CUL.

Landscape Architecture²

Landscape architecture at SLU was reorganized into two distinct departments at Alnarp and Ultuna in 2006. The departments at Alnarp represent strengths in traditional landscape architecture disciplines including landscape management, technology, history, and design. The department at Ultuna is focused on urban planning, ecology, and community development. Each offers similar degree programs and are proposed to be joined together by PhD studies and an emerging "Research School" initiated in 2008. From the outside, the visibility of landscape architecture as one discipline and a robust center of research are limited due to its fragmented structure. This is demonstrated by the following: Landscape Architecture (in the Urban and Rural Development Department at Ultuna), Design Theory and Research in Design, History and Heritage Research, planning Research and Urban Theory, Landscape Analysis and Landscape Planning (in Landscape Architecture at Alnarp), Landscape Development with a Social Science Approach (in the Landscape Management, Design and Construction Department at Alnarp) and Environmental Psychology (in the Work Science, Business Economics and Environmental Psychology Department at Alnarp).

¹ Rural Development, Agroecology, Environmental Communications, Environmental Impact Assessment (in the Urban and Rural Development Department at Ultuna), Sustainable Food Systems (Centre for Sustainable Agriculture at Ultuna) Rural Studies in Forests (Forest Resource Management Department at Umeå) and Work Science (in the Work Science, Business Economics and Environmental Psychology Department at Alnarp).

² Landscape Architecture (in the Urban and Rural Development Department at Ultuna), Design Theory and Research in Design, History and Heritage Research, planning Research and Urban Theory, Landscape Analysis and Landscape Planning (in Landscape Architecture at Alnarp), Landscape Development with a Social Science Approach (in the Landscape Management, Design and Construction Department at Alnarp) and Environmental Psychology (in the Work Science, Business Economics and Environmental Psychology Department at Alnarp).

We note that there are some pockets of research strength in landscape architecture of international importance and scientific promise (especially environmental psychology). There is also considerable overlap between the focus and faculty expertise of research units both within and between departments. In addition, researchers with similar interests and projects are not working together, resulting in a lack of an overall research strategy. As presently constituted, our impression is of landscape architectural research as small competing research units. Research leadership is also lacking. We are concerned that some groups with strong potential will be unable to advance alone without a stronger link between groups and incentives for joint work. In sum, it represents a wasted resource.

Together, landscape architecture at SLU represents an extraordinary opportunity to create an internationally recognized centre of research excellence. Yet given the problems we found research visibility and coherence within landscape architecture, and we offer the following overall recommendations:

The various units and departments related to landscape architecture research would benefit from an inclusive collaborative process to define research directions and foci for the broader interests of landscape architecture. The objectives would be to identify broad, common themes of feasible, productive research themes and mechanisms to maximize the research potential of individual units by collaborating on themes and/or methodologies of mutual interest. Particular attention should be paid to strengthening the visibility and culture of research, including engagement with the professional community of landscape architecture.

The outcomes of such a collaborative process might be the development of an integrated and university-wide Centre for Landscape Architecture Research (CLAR) to bring together the now disparate parts of landscape architecture research activity at SLU. Putting these smaller groups together would form one of the largest research centres of its kind in Europe with over 40 researchers. The components that such a center could include are:

- Clear articulation of research foci/overarching strategies for research
- Target funding for interdisciplinary and cross-unit research activities
- Support and reward mechanisms
- Encourage a FORMAS funding program specifically for landscape architecture research
- Sponsor international and Nordic conferences
- Develop publications (journal, web site)
- Developed a more integrated approach to PhD education

The value of innovative practice and contributions to knowledge and understanding through design-based research should be recognized as a legitimate scientific activity for academic staff in Landscape Architecture. In turn, academics engaged in practice-led research should be encouraged to present clear evidence of the research content and innovation in their work, in a publicly accessible medium, so that others can learn from it and critically engage with it.

Critical reflections on design are needed, including built examples of landscape and planning projects. SLU can create stronger links between professional teaching program and emerging research programs in landscape architecture. For example work- and case studies and post-occupancy evaluations of constructed designs should also be supported as part of research collaborations in landscape architecture at SLU.

Many units are under-resourced. Adequate staffing and increased research funding are necessary, all in balance with appropriate teaching loads. There is a critical need to recruit senior faculty (ideally full professors) to advance the quality of graduate student research and

training that are necessary to become a world-class department. Some units in this department are already exemplary, notably the Environmental Communication Unit. Others show promise and all have potential. The challenge for SLU is to fulfill the promise and realise the potential. The Panel believes that without prompt and adequate attention to these issues, the opportunity to achieve excellence may be lost.

In sum, we find robust and promising research being done by individual or small groups of researchers in the area of landscape architecture, urban and rural development and sustainable agriculture. Yet many are isolated from one another and as a result their impact beyond Sweden and the Nordic countries is limited. However, taken together, they have the promise to be a leading centre of landscape architecture and planning research in Europe and throughout the world. This will take new structures and innovative programs beyond what has been accomplished to date in the SLU reorganization of landscape architecture and planning at SLU.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 260_6, Rural Studies and Forest

B 1. General assessment of the Unit of Assessment

The unit was established in 2007 in the Faculty of Forest Sciences – the only unit from this faculty that our panel of experts was invited to assess. They are based in the Department of Forest Resource Management. It involves work both in the Nordic and north European context and in southern developing countries. The unit is apparently unique within its Faculty in having a focus on human-induced change processes that influence rural communities as well as the inhabitants' conditions and problems concerning the use of the forests. There is a particular interest in research on small, family-owned forest units and forest commons. This is an important area for research in the context of the local economy but also in relation to world-wide issues of sustainability and ways in which sustainable communities in rural areas can contribute to a healthy society.

The approach is interdisciplinary and includes descriptions and analyses of the current state as well as change processes occurring at both the local and landscape level. The connections between natural resource use, stewardship, ecosystem production, and associated community development processes, are under study, and require development of new methods for data collection, analysis, and communication with users. The unit is involved in good networks to benefit its research at a local level, e.g. in northern Nordic countries, as well as within Europe and beyond, e.g. with IUFRO. In relation to Africa and Asia, the unit chairs UCTREE and is involved in coordination of a major university cooperation with Wondo Genet Ethiopia, involvement in FAO Global Forest Resources assessment and research cooperation with CIFOR in Africa and Southeast Asia. Although the unit does not formally undertake work on environmental monitoring and assessment (FOMA), it makes intelligent use of data captured through its Department's competence in environmental monitoring, forestry scenario analysis and planning. This is complemented with studies of formal and informal institutions that contribute to an understanding of the use of natural resources.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Although rural studies is a common theme across several research groups and institutions, this is one of the few with focus on the utilization of forest land/forest as a resource in a Boreal context, taking a landscape approach and a local, community- and municipality-based perspective. Both here and in the unit's work in a global and tropical context, the linkage between forest resource assessment and monitoring and socio-economic and environmental issues at a community level is a potentially valuable one. We were particularly impressed by

the kinds of valuable insight into the economics and sustainability of forestry that can be gained through a gender studies approach and Lidestav has begun to make an important contribution here. There is a reasonable level of external income attracted, with a particularly impressive 18.3 MSEK grant from SIDA.

The publications profile shows some useful outputs but a heavy reliance on one journal in particular: *Small-scale Forest Economics Management and Policy*. Lidestav has been an active researcher in this regard. The more recent publications by Sandwall in different locations, such as *Ecosystems and Environment*, are a good sign of attempts to widen the impact of the unit's research. The unit recognizes the need to be able to recruit researchers with a background in social science and to strengthen the quality of their work through a solid basis in social science theories, methodologies and understandings.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The Unit recognises that there is a challenge to build up sufficient critical mass and a distinctive profile. It has made a valuable early contribution to developing its profile through the 20% appointment of political scientist Carina Keskitalo. There is also great potential in its involvement with the 'Northern Rural Areas in Transition' Research School, based in the Department of Urban and Rural Development at Ultuna. Coordination and membership of international networks such as in IUFRO and CIFOR are valuable signs of recognition, as are invitations to contribute expertise, e.g. to FAO/UNECE and SIDA. However, there are comparatively few invitations to speak at national and international scientific conferences to date, confirming the need for the group to develop a higher profile.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Forests are one of the most important ecosystems on earth and the understanding of the interaction between humans and forest ecosystems is of outmost importance. A well planned and sustainable forests resource management strategy is one of the cornerstones of a sustainable future. Therefore, research on this subject is of very high importance and relevance. The interdisciplinary approach by the UoA is also regarded as relevant and the chosen research fields; forest management planning, remote sensing, forest technology, forest inventory and environmental monitoring, are all of high relevance. However, even though there is a huge potential for the UoA to have impact on the society, this was not very much reflected in the Self Assessment, nor in the presentation. It appears that the UoA mainly focussed on their own areas of interest and the science itself – not the outreach of the results to the many wider stakeholders and potential communities of interest. Therefore it is difficult to see that the research performed by the UoA has had any major impact on society up to now.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

Geographical: a) regional/national but with some c) global in relation to SIDA supported work.

Temporal: a) and b), short- and medium-term perspectives

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy for developing the unit seems reasonable. The aim to develop research taking gender perspectives on management and use of forest/forestry and rural development is appropriate and relevant. Integration of global and local dimensions and rural-urban dimensions of the research area is also a valuable aim.

The development of a critical mass of researchers will require investment in professorship(s) and better support for PhDs. There appear to be existing and recent PhD students interested in this area of study, so there is potential here.

The gender balance is good. However, the synergies between different UoA's at SLU with expertise in social science could be developed much further. In particular, the skills of the Department of Urban and Rural development in social anthropology, especially in the Rural Development UoA, could be taken more advantage of.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

N/A

B 4. Actions for development at the Unit of Assessment

At present, the unit has no full professor and relies heavily on contributions from Ohlsson, who has no formal appointment within the University. As indicated above, the development of a critical mass of researchers is needed and will require investment in professorship(s) and better support for PhDs. The unit recognizes the need to be able to recruit researchers with a background in social science and to strengthen the quality of their work through a solid basis in social science theories and methods. They are correct in identifying this as an area that needs attention. In addition, the unit needs to take advantage of links with Rural Development and other units in the Department of Urban and Rural Development at Ultuna that can contribute sophisticated and well developed social science understandings, theories and methodologies.

The research being undertaken appears to be of good quality but the unit needs to pay greater attention to dissemination in a wider context. This applies both to publication in a range of

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⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

journals, especially but not exclusively non-forestry journals, and to exploring how their work might influence policy and practice at all levels, from international, national and regional to local community development and support. This is as true of the work in developing countries as it is of research in the Nordic context. At present there is poor recognition of who their research 'customers' or end-users might be, other than the scientific community.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 595_1, Rural Development

B 1. General assessment of the Unit of Assessment

The Rural Development unit was established 1995 with focus on rural development in developing countries. It was reorganized as late as 2006, when there in Sweden was an urgent need to catch up with a fast growing research on “the new countryside” / “the new role” of the countryside throughout Europe and in the Nordic countries. The overarching, ambitious and important goal of the unit has been to establish a platform where these two traditions of Rural Studies can meet and nurture each other.

The unit has already demonstrated its vitality and important role for SLU as a whole. New master programs and research schools have been established within a broad multidisciplinary frame, including several disciplines in social sciences and humanities as well as in agronomy. The number of applicants to the new programs has been impressive, which indicate the unit’s societal relevance.

The rapid expansion of the UoA during the very few last years has created a situation where there is an obvious need for recruitment of additional senior staff in order ensure that the impressive results from the establishing phase can continue during coming years.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA encompass a good combination of basic and needs driven research. The multidisciplinary and comparative perspective is essential for all research in the unit. The staff has a high competence in qualitative research methods. A broad spectrum of theories from social sciences are used in order to get a better understanding of processes of stabilities and change in rural areas, but also of links and interaction between new forms of “urban demand” and “rural supply”. Since PhD students are recruited from a broad range of disciplines, the unit has a crucial role in teaching social science theories and methods to students that might have a relatively restricted knowledge in these areas when starting their Master or PhD studies. The dissertations published so far indicates that the unit has accomplished high standard.

The unit has the ambition to relate / integrate rural studies focusing on developing countries with rural studies embedded in modern or “late modern” societies. This high ambition requires theoretical studies / participating in theoretical discussions on global processes. Via visiting professors parts of this global discourse has been nicely present at the unit but in

order to be an active part in research on global processes more resources is needed.

Via the tradition of development research the unit has access to a broad international network in developing countries. The unit is also well connected to central Nordic research milieus. It is on its way to connect to key European research institutions (for example the Rural Sociology Group at Wageningen) but is for the moment not funded from central EU research programs.

Since the unit was reorganized as late as 2006, it is too early and therefore difficult to make a definitive rating of research productivity and quality. Taking into consideration the importance of publishing also in Swedish for a broad range of national audiences', which the unit has fulfilled with high quality, we have scored the scientific quality with 5 although the international peer review publications do not fully reach this level.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit has a well recognized position in a national and Nordic setting concerning Rural Studies connected to EU policy on rural development issues. Its position in studies focusing on rural issues in developing countries seems well established with a large ongoing program in Vietnam and networking with many units throughout the world. The expansion of both teaching and research activities since the reorganisation 2006 has been impressive. When scoring the unit with 5 its is also based on the potentiality we think this unit has for becoming a vital centre for Rural Studies both in a European and global scale.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The field of rural development is a very important research field, both nationally and internationally. The relevance for the society is unquestionable, as for example the dramatic increase in food and energy prices during 2008 indicated, and must therefore be regarded as an important scientific area. The UoA has chosen to work both in "the North and in the South" and is integrating studies from these two areas. Contact with stakeholders is important and well treated, even though the research field could benefit from further enhanced interaction with stakeholders. Taken all stated above together, the research done by the UoA is regarded as having very high importance for the society.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

The UoA has an important impact both at a national, European and global level. It is one of the very few in Northern Europe focusing on all the three levels. Key areas of research (nature resource management, the food sector and bio-energy issue globally, social change processes and stabilities in rural areas both in “the South” and “the North” etc.) can only be understood in long term perspectives. The unit’s collaboration with historical sciences (history of agriculture, history of land use more generally etc) should be supported.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The overarching goal of the unit is to be a platform where multi- and interdisciplinary studies on rural issues in a globalized world can take place. For key research themes have been formulated:

- a) Natural resource based production, management and social sustainability
- b) Globalization and its relations to local communities and landscapes
- c) Rural heterogeneities and diversities in relation to policies and local identities

The research strategy is of high strategic relevance for SLU as a whole. Through Rural Studies highly intertwined issues of food, energy, environment and basic socio-economic development can be depicted. The unit stresses the importance of collaborations with other units and the use of interdisciplinary perspective. The evaluators consider this strategy well formulated and with a high future potential. This is exemplified by ongoing research on three interconnected tracks: a) the interplay between policy and local communities; b) the politics of landscapes and c) social sustainability.

According to the self-assessment and during the hearing the UoA stressed the need to get additional resources for teaching since the unit is deeply involved in education, which is underfinanced.

The gender balance in the UoA is good. A large part of the staff has been recruited to SLU during the very few last years and the age structure seems good.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The UoA is mentioning Rural Sociology Group, Wageningen University, The Netherlands; Norsk Senter for Bygdeutvikling, Norway and Joensuu University, Finland, as suitable for benchmarking of the unit. These are all highly relevant institutions where existing links can further be developed for comparative research especially within a European (inclusive East Europe) frame of reference. As well the unit is networking with a high number of institutions focusing on developing issues in the "South". Good links exist, the next step should be to actively seek research money to strengthen comparative research for example with the mentioned institutions.

B 5. Additional information

Strengthening of the staff with high qualifications in social science theory and research methods should have high priority since the social science dimension of research at SLU gives additional value to several areas of natural sciences.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 595_2. Agroecology

B 1. General assessment of the Unit of Assessment

This UoA is carrying out research on how to apply ecological concepts and principles to the design and management of sustainable agroecosystems. Improving our understanding of the relationships between land management, food production, energy use and environmental impact is vital for the future of society. The truly inter-disciplinary nature of research within this UoA is exciting and of great relevance to societal development. However, the further development of the unit is hampered by the lack of recognition for agroecology as a discipline. The research being done here by a small number of dedicated scientists is worthy of further support from SLU including the appointment of a Professor in Agroecology.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This UoA has a history of interdisciplinary research which is published in appropriate journals. The focus on Participatory Learning and Action Research (PLAR) is appropriate to the subject matter. The UoA is internationally recognised not only in the Nordic countries but also for its work in developing countries. The ability of this group to win grants and participate more widely in international networks would be considerably strengthened by the appointment of a Professor of Agroecology and the consequent ability of the UoA to build up a larger core of research activity and PhD students. Retaining the Emergy work of Torbjörn Rydberg is important for this group.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Within agricultural research most groups still use traditional disciplinary approaches. This group have made important progress in integrating natural and social science into systems approaches to solving the problems of modern agriculture. The research of the group deserves wider recognition and visibility than it currently has but this is unlikely to happen until the group is expanded to include some more senior staff with strong research reputations in the field. The work led by Lennart Salomonsson in facilitating Nordic co-operation in agroecology

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

and facilitating social and natural science interactions has been recognised with merit awards. The links to the agricultural industry through stakeholder involvement give important credibility to the research of the Unit.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Modern agriculture has led to a major change in the landscape and has therefore had a tremendous impact on biodiversity, nutrient status of e.g. freshwater systems, etc. In order to better understand this impact and how to manage it, it is of great importance that we understand the management of natural processes more fully. This UoA is carrying out research on how to apply ecological concepts and principles to the design and management of sustainable agroecosystems. The aim of combining agriculture and ecology is definitely very relevant for society in order to implement more sustainable agricultural systems. The work performed by members of the group in the field of bio-energy has been of great importance for the debate nationally, and the Participatory Learning and Action Research (PLAR) has been widely used by different stakeholders. Other research work has been important for organic farming organisations e.g. KRAV. Since the research field is of high relevance and the UoA's integration with stakeholders is high, relevance and impact on society is regarded as of Very high importance.

Geographical: ALL a: regional/national; b: Nordic/European; c: global

Temporal: c)long-term perspective

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

This Unit focuses on applying ecological concepts and principles to the management of sustainable agroecosystems. Their strategy focuses importantly on building a creative research environment, based on systems approaches. There are few groups in Europe with a real focus on this. Widening the research funding base as home and abroad is also a key strategic goal. There is a need to strengthen the unit and, as suggested earlier, this could be partly achieved by bringing in research activity currently within CUL (UoA 924_1). It is important to note that the scientific principles applied in the Agroecology UoA are broader than the regulatory system of organic farming; however research on organic farming currently in CUL could be nested within this UoA. Organic farming could be used as one of many possible model systems for sustainable agriculture. Strengthening the group with senior staff would increase the potential of this group. The efforts of this group in facilitating interdisciplinary learning in research and education (Agroasis) are to be commended.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

N/A

B 4. Actions for development at the Unit of Assessment

Applying for funding from the European Union Framework programmes for work within Europe and/or in co-operation with developing countries is a clear option for broadening the funding research base and raising the profile of this grouping. The Agroasis network for research and education co-operation could usefully be extended beyond the Nordic countries into other parts of Northern Europe.

B 5. Additional information

SLU should seriously consider recognising agroecology as a separate discipline, thus allowing academic development of this promising Unit. Few groups in Europe are strong in this area and it could become an important strength of SLU.

Links to other staff working on systems related issues in departments such as Crop Production Ecology, Agriculture etc should be fostered. There is potential for a postgraduate research school in agroecology which crosses faculties.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 595_3 Environmental Communication

B 1. General assessment of the Unit of Assessment

In the 2.5 years since the UoA gained a full professor, the Unit has distinguished itself in research productivity and quality. The Unit is strengthened by a mix of disciplinary backgrounds and competence that supports a strong capacity for robust, applied research. This is based on valuable interaction with stakeholders at the heart of complex environment management issues. Being located in SLU allows for engaging research questions that bridge EC and agricultural extension and environmental management issues. The Unit participates in many international networks and collaborations and establishes them as well. It has published across a wide spectrum of It has achieved respect and legitimacy of a broad range of government agencies, communities, interest groups, and colleagues. Its most significant value of its research is the application of it to real issues to not only build the capacity of stakeholders in communication behaviours but also to influence the likelihood that decisions for sustainability will be the outcome of stakeholder processes. In the 21st century of global environmental, economic, and social-cultural challenges, the highest mission of any university is the practical applicability of its research. The EC Unit is distinguished by its unique ability to do this while retaining robust research standards. The Panel perceived this Unit to be the strongest Unit of all we reviewed. SLU should do all it can to support the further building of EC excellence.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Environmental Communication is distinct in its epistemological and methodological stand that is applicable to a broad range of environmental topics and situations to produce policy results, best practices, and decision making for sustainability. The EC Unit has produced five PhD dissertations in just over five years, published in a number of formats and venues, contributed to theory development, and established two new masters degree programs, among other achievements

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

Given that it has been just over two years since obtaining a full professor, this Unit has distinguished itself with Swedish government agencies (EPA), industry, communities, and among international academic colleagues. Faculty serve on the editorial board of the premier journal *Environmental Communication: The Journal of Nature and Culture*. They strategically network with Swedish and overseas researchers and partner within international networks and within developing countries detailed in the Self-Assessment. They serve as board members of and in leadership capacities of various associations. Faculty have won awards for outstanding achievements in research.

The Unit also attracts a steady stream of high calibre visiting professors and other visitors, including the current visiting professor, Dr. Tarla Peterson, who is spending six months for each of two years with the Unit. Dr. Peterson is an endowed chair at Texas A & M and a distinguished international leader in environmental communication. The Unit faculty and students present at diverse conferences and workshops and this facilitates the production of research for publication. It also has created an ongoing and popular conference and workshop series for Swedish practitioners. Finally, the Unit has established two new masters degree programs that have demonstrated high student appeal and research potential.

On the basis of this evaluation, award a score from 1-6 ²:

5

3. Relevance and Impact

The most powerful obstacle to decisions for sustainability is the lack or dysfunction of communication among competing parties. In order to secure that environmental issues have the highest likelihood of being resolved for sustainability, we must understand and build skill capacity in communication dynamics. As a base for this, a good understanding of underlying processes is vital. The UoA is doing research in a wide range of communication areas, which to a certain extent is somewhat difficult to evaluate as a group. The relevance of its research is very high: working with the understanding of emergent processes of social change; social interactions such as conflicts; learning and negotiations concerning natural resource management; and collective actions in the context of environmental issues. The UoA seems to have developed a productive way of working and possesses a large societal network, inside which there is also vibrant interaction. Understanding of situations and development of tools for stakeholders (e.g. municipalities) is an important part of the development of a sustainable society. Therefore both the relevance of the research being performed and the resulting impact are regarded as having very high importance for the society and stakeholders.

Regional/national; Nordic/European; growing international. To date, most projects have been small and defined; nevertheless, the impacts are long-term.

On the basis of this evaluation, award a score from 1-6 ³:

5

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

Of the units the Panel assessed, the Environmental Communication Unit is arguably the best positioned to make exemplary contributions to not only their own field but also the quality of natural resource management decisions and policy. In a very short time period since it secured a full professor in March 2007, this Unit has demonstrated its ability to secure funding, attract Ph.D. students, reach across boundaries to other units, identify a feasible and important research agenda, achieve international recognition, and build productive relationships with agencies and communities. This Unit is comprised of students and professors that have very carefully considered the current and future roles of their Unit. They have explicitly strategized to not only make significant research contributions to the work of environmental communication and other fields/disciplines, but also improve decisions making for sustainable ecosystems, including human communities. We were impressed with their competencies, commitment, and demand for their services. They are internationally engaged while also building the capacity of the Swedish Environmental Protection Agency, interest groups, and citizens to play productive roles in making decisions for sustainability. We anticipate that this Unit might also strengthen other Units with social science capacity or aspirations via collaborations. Such units are Rural Development, Landscape Planning/Architecture, Agroecology, and Rural Studies in Forestry. No competition exists with any similar campus in the SLU system, so this Unit has already distinguished the Ultuna campus. It also has the opportunity and ability to be a leader to knit together a powerful coalition of SLU and international, multi-disciplinary researchers. To do that, the Unit needs and deserves an increase in institutional support such as faculty support, the promotion of faculty to associate professors, and the revision of research performance measurements to account for the critical contribution of social science research in the 21st century.

On the basis of this evaluation, award a score from 1-6 ⁴:

6

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA is working with the Environmental Assessment Unit on joint applications. The list of proposals includes two (#s 6 and 8) that are joint with a group of aquatic assessment researchers led by Kevin Bishop. Members of the UoA have also been part of two large but unsuccessful grant applications in 2007 and 08.

This Unit has submitted several proposals for FORMAS funding, as an individual unit and as a collaborative partner with other units.

B 4. Actions for development at the Unit of Assessment

This Unit is on the right track to strengthen its research and the relevance of its research, evidenced by its appeal to students, agencies, international peers, communities, and citizens. It deserves funding, full-time faculty, space, and University recognition.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

This Unit is a unique mechanism to distinguish SLU nationally and internationally in an increasingly complex and contentious world of multi-sector, multi-objective natural resource management decisions. Take advantage of it.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 595_4 Landscape Architecture

B 1. General assessment of the Unit of Assessment

Landscape architecture is a large group of faculty within the Department of Urban and Rural Development at the Ultuna campus, although a majority is responsible primarily for their teaching programs. Presently it is a faculty with backgrounds in landscape architecture, architecture, planning, systems theory and biology. It also includes a large group of landscape architecture professionals who teach on a part time basis, including Thorbjörn Anderson, a landscape architect with a major international reputation. Landscape architecture within the department is particularly teaching focused, something that will need to be better balanced with research as the department develops over time. In addition, it is expanding its international activity in both research and teaching.

As reported by the unit, they currently have a Professor in Strategic Planning, a Professor in Landscape Architecture, a Professor in Sustainable Community Development, a Professor in System Analysis, a Visiting Professor in Landscape Architecture, and an Adjunct Professor in Landscape Architecture. Additional faculty hires anticipated include a Professor in Design Theory and Professor in Landscape Architecture due to retirements in these areas. In addition, they report two Associate Professors, two Assistant Professors, three Senior Lecturers, and about seven active PhD students.

The unit reports their research themes as design theory and methods, urban plant soils, children and urban environments, landscape analysis, history and sustainable community development. They do this thru focused research at a variety of scales from the site to the town to the region. In addition to studies in Sweden, they are engaged in research activity and partnerships in the Baltic Region, India, New York, Asia and South America. They have recently established a two year international master's program in landscape planning. They appear to be gaining momentum in research productivity and are "on our way" to become a research centre of excellence in landscape architecture and planning. The unit has strong and well known areas of expertise especially in community design and development.

The group is largely in transition as a result of recent reorganizations and still defining its research focus. At present, it lacks a strategic plan for research, something currently under development. It is difficult to fully assess its research strength given the evolving nature of its research program. However there are established areas of research strength in areas such as children and planning, design methodology and community development. Some of these are published in leading journals and are distinguished internationally. Yet much of the research is also evolving. With large numbers of students and heavy teaching loads, this poses a special challenge for this group as it strives for research productivity and excellence.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Faculty articles were published in major journals including Landscape and Urban Planning, Landscape Research and Urban Forestry and Urban Greening, all important refereed journals in landscape architecture. Several also have been published in the Nordic Journal of Architectural Research (Nordisk Arkitekturforskning). This averaged between 3 and 13 refereed articles per year during the review period. Two books were also published including one on soundscapes and another on habitat and local communities. We suggest that researchers also consider submitting their work to other major journal including Landscape Journal and Journal of Landscape Architecture (JoLA) and publishing synthetic books in their main areas of research focus. In addition, they have published a large number of reports and monographs, including many in Swedish. Eight PhD dissertations were produced last years according to their presentation to the review panel. They are conducting scientific writing seminars to advance faculty and study efforts in publication.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit is regionally distinguished as a centre of landscape and planning research with an emerging international presence. They are especially interested in contributing to the development of theory in landscape architecture and could potentially lead the debate in this growing area of scholarship and discourse. The unit appears to have an emerging tradition of research and scholarship. They are attracting an impressive amount of external funding and appear to have created a strong administrative home to pursue focused research. They point to a heavy teaching load that has hampered their productivity but with increased research funding and growing number of PhD students, “feel confident” in their growing research productivity. Especially noteworthy is the awarding of the Europa Nostra Award to Nils Ahlberg for his ground breaking dissertation in 2005. While impressive to date, the panel ranks their efforts as modest and promising and believes they need stronger collaborations with similar colleagues in SLU and elsewhere to fully realize their potential.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

This unit represents a large number of people (UoA size of 17 people) and it is somewhat difficult to evaluate all of it as one single piece of work. However, the importance of the work being performed by the group is determined to have a large impact on society and given a high score of importance and relevance. Much of the work being done is regarded as having influence on many parts of landscape architecture at least at the national level within Sweden.

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

Collaboration with stakeholders is relatively extensive and is producing useful tools for municipalities, consultancy firms, etc. It is bound together by a coherent outreach strategy and we deem it likely that their collaboration with stakeholders will increase further in the near future.

Nordic/European; Medium, long-term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

As stated to the panel both in the self-assessment and in the unit's presentation, a strategic plan is currently under development and is "a work in progress". No details of this plan were presented and as a result it is difficult to fully assess their future research priorities and direction. However we see evidence of potential in this unit, especially when linked to other strengths in landscape architecture at Ultuna and with the similar sized landscape architecture related units at Alnarp. This is a strong interdisciplinary group that will be strengthened by new hires at the senior faculty level. We urge the faculty to develop greater capacity in landscape architecture research by appointments of landscape architects with strong research experience and ability to inform the profession of landscape architecture. They can also make greater use of adjunct faculty with strong international reputations as part of their strengths in research and creative work on landscape architecture. We urge the group to be more visionary in their approach to landscape architecture and develop stronger linkages within SLU and elsewhere.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

No environmental monitoring or assessment

B 4. Actions for development at the Unit of Assessment

We note a strong difference between research-oriented faculty and outside professionals and faculty charged with teaching. We see this as a potentially unhealthy divide especially as the department develops over time. We suggest that creative work of practitioners as recognized through outside publications, awards, exhibits or winning of major competitions be included as part of the research strength of the department.

While interdisciplinary in nature, we were troubled by the lack of overall focus on the profession of landscape architecture and an overreliance on "architecture" in the unit. While this may be more the Scandinavian tradition, greater attention to the research needs of the profession and its impact on society is needed to for their research activities to have a larger impact outside Sweden.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

As we note in Part A, there is considerable lack of research collaboration between faculties and units between this unit, the Ultuna campus and others on the Alnarp Campus in landscape architecture, landscape management and environmental psychology. While there may be historic and structural reasons for this split, we see this as especially hindering research advancements in this unit. The department plans to address this through its newly established “Research School” APULA – Architecture and Planning for the Urban Landscape (<http://www.sol.slu.se/la/res/researchschool.pdf>). This represents a significant investment of 5 million SEK from 2008 – 2012. The faculty believes that over time this will address collaboration and interaction between the different landscape architecture faculties at the two campuses. While this is a positive direction, we suggest a stronger and more inclusive framework be established through the establishment of a university-wide “Centre for Landscape Architecture and Planning Research” (CLAR) as stated in our summary Report A. They should also consider producing a journal of landscape architectural research for the Nordic region and perhaps more broadly.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 595_5 Environmental Impact Assessment

B 1. General assessment of the Unit of Assessment

The Environmental Impact Assessment (EIA) Centre was established in 1999 as a centre to carry out applied research studies, education and outreach activities in the then relatively new area of impact assessment. The Centre did not, as we understand it, have a real research mission until 2005, when external funding allowed expansion and appointment of an associate professor/senior lecturer who joined in 2006. Now the centre has 6 staff involved in scientific research, 5 staff involved in applied research and 7 staff that make up the SIDA help desk, which gives advice and carries out capacity building work especially in developing countries. The SIDA help desk also does not fall within our remit as it does not have a research function as far as we could see. The multi faceted nature of the unit, with these three different components, made it quite difficult to make overall assessments, and our focus has been mainly on the scientific research component. The research focus of the unit has emerged relatively recently and many of the statements in the self assessment are therefore aspirational as there has been relatively little time to produce outputs based on the strategic goals identified. There also appeared to the panel to be some difficulties inherent in the divided missions of the scientific and applied sides of the unit's work, each of which has a different leader. The strategy in the self assessment is very much based on the vision for scientific research and we concluded that greater integration and sharing of the vision would be beneficial. The Centre has some high quality publications in refereed journals and was able to provide a new and updated list with larger numbers compared with SLU's official list of publications. Citations appear relatively high, but we have some concerns that the publication profile seems quite highly dependent on papers by a visiting post doctoral researcher who is not a permanent member of the unit. Overall however the unit is performing well and has good potential to achieve more in the near future.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific, as opposed to applied research, side of the UoA has been established relatively recently. It is therefore early to make meaningful judgments about research quality. The mission statements and summary of present research activities indicates great ambition, a wide range of research themes, some quite innovative ideas, and a range of existing collaborations, both internal and external. Publications seem to be emerging steadily, based on the updated information provided during the presentation. They include a good number of peer-reviewed papers in respected international peer-reviewed journals and several more are

likely to emerge in the near future. Overall we judge the scientific quality of the unit to be internationally recognized. Our assessment must however be qualified by two concerns. Firstly the journal publications are at present dominated by one author [Mat Cashmore] who is a post doc, shared with the University of East Anglia in the UK. His post at SLU is only due to last until 2010 and so arguably his contribution to the unit's profile is temporary. Secondly we gained the impression of some separation between the relatively new social scientific research agenda and the more applied research and outreach activities of the units. In our view the unit should be closely integrated in all its activities with each supporting the other. The vision needs to be shared between all concerned in order to maximize the quality of output

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

We judge the unit to be moderate in recognition and leadership at this stage in its development. We note its engagement in Sweden in the MIST programme, involvement in research funded by Formas, and the contract with the Swedish Environmental Protection Agency. We also notes the involvement of the UoA as leader of a work package in IMP3 under the EU 6th Framework Research Programme. These projects contribute to an increasingly active research environment and there are clear signs off external recognition of key researchers as he and other aspects of this evaluation the investment in employing a docent associate professor/Senior lecturer and bringing in postdocs is only now beginning to bear fruit. We anticipate that recognition and leadership will increase in the near future as the benefits of this investment are realised.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The panel found it difficult to evaluate this area because the original EIA Centre, including the SIDA Help desk works directly with stakeholders and has a specific remit for knowledge transfer/exchange. It must therefore, almost by definition, be of high relevance and should be of high impact. It is hard to judge whether the same applies to the social science research aspect of the unit. The self assessment itself notes that stakeholders are relatively unaware of the value of the social science perspective, with natural science perspectives being given greater attention. There is therefore scope for the relevance and impact of this aspect of the units's work to be developed further in future. The potential impact of this UoA on society is therefore deemed as not yet fully explored, but is still regarded as having high importance. This is mainly due to the fact that the relevance of the research field for the society and stakeholders is very high, even though the actual impact of the research performed by the group could be increased by introducing more collaboration with stakeholders working with

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

EIA's daily (municipalities, consultancy firms, etc). The UoA is not allowed to do consultancy work, but is expected to be in close contact with what is happening in the society and to be a part of the development of the EIA process in the society. This potential is not regarded as being fully realised and a weakness is the relatively low recognition of the UoA and their work by stakeholders. Visibility needs to be improved. The work with Sida Helpdesk is regarded as important, but does not really belong to the EIA research area and is therefore not covered in this evaluation.

The relevance and impact is judged to be of high importance at a Nordic and European scale (we do not take account of SIDA's overseas work] and in a short/medium and in some cases long term timescale.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The unit has a reasonably well articulated strategy for the next five years, which was elaborated on during the presentation. We were also glad to read and hear that the staff recognise the need to bring the different strands of their activity together so that the sum becomes greater than the parts. We were not clear about exactly how this was to be achieved and are unable to judge the likelihood of success. Nevertheless we encourage positive action to achieve this in the near future. We were surprised to hear that the unit is explicitly banned by the University from undertaking consultancy contracts, presumably because competition with the private sector is not permitted. We understand this, but think that there should be scope for the unit as a whole to work in partnership with consultancies to improve practice in EIA, while also perhaps at the same time generating some additional income. Taking account of all these points we judge the unit's strategy and potential to be very good and in some ways comparable to the Environmental Impact Centre at Manchester University.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Given the applied nature of much of the unit's work we were surprised that they had not engaged with FOMA. This may be because none of the current programs are relevant but there would seem to be good potential in the future to introduce the idea of monitoring of EIA and other forms of IA. This could include quantitative and qualitative monitoring of the implementation of EIA, development of review packages for impact statements, monitoring of stakeholder responses to environmental statements and monitoring of outcomes against predicted impacts. Active engagement with FOMA would be needed to promote these possibilities.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The unit has expanded in recent years and new research leadership has been introduced. There is, however, no full professor, and many of the staff lack secure funding for posts. The strength of the unit would be enhanced if these issues could be addressed over the next five years. Beyond this the unit has itself identified a range of actions that it needs to take internally to enhance its performance and standing. It should be supported in pursuing this action plan by its home departments and by the Faculty and the University.

B 5. Additional information

The unit has a strong social science focus and is rightly located in the Department of Urban and Rural Planning. The SIDA work sits comfortably alongside others in the Department working on research and outreach to countries in the southern hemisphere, especially rural development and agroecology. But IA/EIA involves a wide range of disciplines and SLU offers scope for collaboration with many different people, for example in Landscape Architecture, ecology and economics to name just a few. The unit does seem to have made at least some of these links but there may well be scope for more active collaborations.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 636_1 Design Theory and Research Design

B 1. General assessment of the Unit of Assessment

The main object of the study of this research unit is contemporary landscape architecture arranged around aesthetic theory with focus on visual representation, rhetoric with focus on 'designerly' knowledge practices, critical historiography with focus on modern/contemporary landscape architecture, performativity focusing on methodological experimentation and pedagogic research, professional practice and learning. The research is oriented towards inter-disciplinarity and has a combination of theory and practice. The close affiliation with professional practice presupposes a close integration of research, studio work, modelling experiments, participatory processes and artistic practice. The unit wants to work towards a deepening of the theoretical reflection and in the study of methodological and representational questions related to changes in society and media because representation, reproduction, dissemination and mediation have become major concerns for researchers in all fields. Their niche is rhetorical approach to design research and practice focus on design as action or reflection in action based on practice based research, research by design, research in-and-through-the arts. Their mission is to reflect upon and contribute to the general paradigmatic shift, exploratory design practice, how new landscapes are being constituted and reproduced, where and by whom and under what circumstances. Altogether the ambition is to generate a sustainable urban development dealing with constant change.

Research by design is discussed internationally today and needs special attention. This UoA have ideas that might be suitable for this discussion with their knowledge and insight in media, IT-technology and art. But research by design is not the same as design research. And the unit needs to reflect on those two aspects. They rely largely on methods taken from the art-world but it is important not to transform those methods uncritically and forget that landscape architecture as architecture as opposed to art must be responsive to broader environmental and social concerns. One of the central disciplines and important competences of the Landscape Architecture profession is to be able to rate quality of the urban landscape; when it is a matter of preservation of existing spaces as well as of establishing new landscapes. When we talk about architectural quality in the urban landscape, we can overall restrict it to two aspects: a communicative, which is about artistic quality and the capacity to disseminate identity, history, stories and experience and a regulative one, which is about functionality and environmental matters. It is not enough with economic and technical/environmental valuations. We need tools for rating sustainable, architectural, aesthetic and artistic quality.

A rating cannot take place on basis of personal taste, but must be built on theories and carried out following defensible methods, so that the assessment and its interpretations and conclusions can be discussed. The unit need to critically reflect on design research of landscape architecture; built examples as well as unbuilt projects; work studies as well as case studies. It is crucial to provide the profession, students and society with methods to discuss and assess past, present and future projects.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - Research1. Scientific Quality

The staff consist of 2 artistic professors (Pär Gustavsson 100% and Carola Wingren 50%) 2 senior lecturers (Eva Gustavsson and Maria Hellström Reimer) 1 senior lecturer on artistic merits (Anne Bergsjö) 2 lecturers (Anders Westin and Juan Carlos Peirone), 1 PhD student (Carola Wingren, 50 %) and 1 research assistant (Sabina Jallow).

Though the article production is high, the list of blind peer-reviewed articles is rather short. In a 5 year period the group has published 2 scientific, peer-reviewed papers, 2 dissertations, 16 book chapters, 1 book, 3 reports, 11 conference proceedings, 2 articles in daily papers and 12 articles in popular scientific magazines.

The research-grant situation is as follows: 1.6 mill in 2006, 1.4 mill in 2007 and 0 in 2008. Ongoing grants are: from Formas 0.05 mill for 2008-2010 (Land Use Poetics), 0.2 mill for 2007-2009 (Development and Design of Memorials in Contemporary Urban Space) and 1.4 mill for 2006-2009 (Aesthetics and Meaning in Modern Garden Design and Landscape Architecture. From VR, 1 mill for 2006-2009 (Cinescape – Intermediary Urbanism and the Filmic Imaginary). The unit has no PH.D degrees awarded during 1998-2008.

The self assessment points out cooperation with Cambridge University, School of Architecture/DIGIS, Technische Universität Wien/Belgrade University, Chalmers University of Technology, The Royal College of Technology, Stockholm, Lund College of Technology, Århus School of Architecture, University of Copenhagen, and Oslo School of Architecture.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Pär Gustafsson has been awarded the Kungliga Skogs och Lantbruksakademin and Carola Wingren is member of Kungliga Skogs och Lantbruksakademin.

The unit is among others collaborating with the Swedish Road Administration around the development of 3D simulation and animation.

Maria Hellström Reimer is member of the international expert panel Intermedia, Oslo, board member in Nordic Association of Architectural Research and member of the programme committee NORDES. Eva Gustavsson is the Swedish coordinator of TEMPUS Lenné.

Carola Wingren is a member of the Swedish Architects academy for landscape architecture. Maria Reimer Hellström has exhibited solo at Galerie Leger, Malmö, 2005

Carola Wingren has been member of the jury in the competition on Main Square Eskilstuna 2004-2005 and Pär Gustafsson is jury member in the competition about Narva Castle, Estonia 2008.

The unit has no PhD students, no postdoctoral fellows and no guest professors.

The research environment they have created seems rather attractive, the leadership democratic and inspiring, the level of cooperation and communication within UoA, and the openness to new ideas is high.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

To stress the significance of aesthetics to society is an important assignment. When successful, it can improve the quality of the urban landscape and lead to a higher degree of sustainability. The UoA's ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry is promising.

The UoA has contributed to discussions related to the governmental bill of establishing of an arts-based doctorate i.e. as representative and responsible for SLU's statement in the matter and has pursued work in development new assessment criteria for appointment in artistic disciplines. This might have impact on future teaching.

The UoA claims to have contributed to a general increase in aesthetic awareness in societal sectors, i.e. traffic infra-structure such as railway and highway development.

The idea of design by research is global. This is discussed at art and architecture schools all over the world. The unit has taken part in this discussion at conferences but proper international impact is not yet visible. Nationally the members of the unit have had impact on SLU's establishment of artistic professorships. This will certainly have impact on teaching but not necessarily on the academic, scientific research and knowledge. With regards to content, depth, breadth and multi- and interdisciplinarity the current research profile of the unit has a high ambition which it is not possible to fulfill under the units conditions of today. Especially this group needs professors with academic qualifications.

Even though design is an important part of landscape planning and landscape architecture, the research performed by the UoA was regarded as having little importance for the society. Most of the impact that was presented by the unit has in fact to be regarded as internal and very little evidence for external impact was presented to the panel. The UoA valued the interaction with stakeholders as important, but this was not reflected in what the UoA actually has achieved so far.

On the basis of this evaluation, award a score from 1-6³:

2

4. Strategy and Potential

The unit in their own opinion needs 2 more associate professors, 4 PhD positions, 2 or more longer visits for PhD students and senior researchers at foreign universities, 2 or more longer international visiting professorships, strengthen of the international publishing frequency, arrangement of 2 or more international seminars and 1 international conference within the field of arts-based research in landscape architecture

The strategies of the unit is to develop mentoring activities through international networks, further linguistic education and linguistic support, to strengthen the theoretical and methodological foundations in post-graduate education and the technological competence and support and further enhance theoretical awareness also on the undergraduate level.

Over all the unit has the potential to contribute to development of society, sustainable urban development and changing landscapes. The conditions could be strengthened at the senior researcher level and the supervising competence, to increase a number of doctoral dissertations, to intensify international exchange and improve technological infrastructure.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The unit is enthusiastic and have great visions for and expectations for the future. The goals and strategies are ambitious and possible under good conditions but need much more support and focus. The unit has a large network and have shown ability to raise research money from traditional sources and other foundations.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The unit is doing no environmental monitoring

B 4. Actions for development at the Unit of Assessment

This unit is enthusiastic, has a fresh view of landscape architecture, and contains experienced seniors as well as young faculty members. The unit has a high degree of interdisciplinarity. This strength can also be a danger. The unit may lose focus of landscape architecture. Even if there is a tradition to bring art and artists into the design teaching and research at Alnarp, the recommendation is to let it be an inspiration and keep focus on the core of landscape architecture and to extend the focus groups to more than students – to practitioners, politicians and other stake holders and decision makers.

Our main recommendation is to combine the research activities of the unit with other related fields: landscape architecture, planning, theory, analyse methods and so on. The co-operations and the networks listed are impressive, but might distract from the core mission. To keep in touch with that many organisations for a small amount of people distracts from researching, writing articles, books and theses.

B 5. Additional information

As presently constituted, landscape architectural research is formulated as a competitive system of small research units and research leadership is lacking. Some groups will be unable to advance alone without a stronger link between groups and incentives for joint work. We suggest that this should be reconstituted into a collaborative system of research and interaction to advance both teaching and research. And this is particularly problematic for this unit.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 636_2 History and Heritage Research

B 1. General assessment of the Unit of Assessment

Agricultural activities and environmental management are as much cultural and social as they are the use of natural resources. The History and Heritage Research Unit of Assessment fills an important need for this important perspective. Past practices, preferences, and decisions are reflected in today's human-managed environment and how humans navigate them. These legacies significantly influence contemporary decisions that have profound implications for the future. To ignore how we got here and how those journeys will influence our future is to ignore a critical piece of human identity and denies us rich insight for sustainable decision making.

The History and Heritage Unit provide a space in which to unpack and understand the “whys” and “hows” of our current situations and allow us to more mindfully choose for the future. Our decisions are poorer without this deconstruction and appreciation, and early 21st century decisions cannot afford to be “poorer” decisions. While this Unit certainly has potential to make a larger research contribution, the value of its research to date is firmly established.

The University should take action to facilitate this Unit's best performance and address institutional barriers to cooperation among faculty with mutual interests. Of special note is the reestablishment of the “TPL” for the study of garden, park and landscape history and heritage; and recognizing and rewarding interdisciplinary research endeavors. For example, History and Heritage Research is multi-disciplinary and would profit from explicit University action or directive to pull together the kindred spirit researchers now assigned to various units. A common graduate History and Heritage graduate program across SLU, and perhaps co-organized with the Swedish Heritage Board, would maximize the strengths of this and other individual units and increase the appeal to students.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This Unit has a strong tradition of empirical and theoretical research. Its researchers and their publications have earned Nordic and some international recognition and respect. However, by the very nature of what this research field requires, the results of its research often cannot be measured in the short term. Nor can it be totally assessed by the amount of external funding it has secured. The results are often cumulative and the external funding opportunities are sparse or connected to particular research perspectives or preferences. Nevertheless, the impact of Historic and Heritage Research is authenticated in the production of theory, policy, and best practices. As is true in many universities, the social sciences and

humanities are not appropriately accorded the very real power they hold in human decision making, nor does the current method of evaluating research account for the “applied scholarship” of this Unit. In addition, heritage- and agri-tourism are growing segments of the tourism industry, reflecting an economic aspect to this research. Via this evaluation process, SLU has an opportunity to improve this situation for interdisciplinary social science research and support a climate for collaboration among like-minded researchers now scattered among several departments or units.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

As noted above, this Unit has been at the forefront of creating and/or maintaining mechanisms that provide interdisciplinary and inter-university opportunities for networking and collaboration. The Garden, Park and Landscape Research Network (TPL) is a strong example, as is the Nordic Landscape Research Network (NPLN). The Unit also plays an active role in implementing the European Landscape Convention. The Unit's members serve on editorial boards, coordinate research networks, and serve as members of community and governmental initiatives. The Unit has secured modest levels of funding from non-university sources.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

This Unit's research has impacted paradigm shifts, theory, educational materials, governmental policy, and management plans. The Unit is caught in a moment of transition that threatens the enduring research quality and productivity of its faculty and students. Within a few years, the Unit will lose its two professors to retirement. The University must plan now to accommodate this; thus the score of 3 on the evaluation scale for this item. The relevance of the research area is established, and the current impact on theory, policy, and governmental programs is clear. However, whether this Unit's ability and potential will be maintained and expanded depends on the degree of support from the University to plan for this transition.

This Unit's research is mostly bound to Sweden and the Nordic region with European impact. By the very nature of the subject, its temporal nature is short to long-term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

As noted earlier, the Unit faces an imminent loss of its two professors to retirement and unless accommodated, this will have significant impacts on the quality of the Unit's research. We also found the articulated goals and strategies of this Unit to lack specificity. For example, it is useful to revive the Garden, Park and Landscape Research Network (TPL), established in 2000. The Network was perceived by its members as quite effective in identifying and linking like-minded researchers across several departments; however, it was not retained in the 2006 reorganization. This connecting mechanism is vital not only to this Unit's productivity and impact but also to support the University-wide, multi-disciplinary nature of landscape history and heritage and maximize the University's presence in implementing the European Landscape Convention. Such a mechanism should be re-established. It is valuable to call for the creation of a graduate degree program in History and Heritage Research. And it is useful to recognize some research topics that the European Landscape Convention and UNESCO World Heritage Convention suggest as appropriate research foci. However, this Unit would be strengthened by more strategic planning so that the future research themes will guide a coherent body of research that builds expertise and distinction. This is especially important as a legacy to be left by the retiring professors.

On the basis of this evaluation, award a score from 1-6 ⁴:

2

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Nothing to report.

B 4. Actions for development at the Unit of Assessment

The History and Heritage Research Unit is caught in a moment of transition. The Unit will likely lose two professors to retirement within a short number of years. Because of the important contribution of this Unit, the University should plan to accommodate this transition to preserve momentum and status. In addition, it would benefit from intensive strategic planning of research themes-topics that will produce a coherent body of research that will establish this Unit's expertise and distinguish SLU. Lastly, the University must explore the approaches and mechanisms that other major institutions of higher education have employed by which to measure applied scholarship. Environmental problems are now clearly recognized as being far more complex than humans managing the environment. It is as much about humans managing themselves, and research on understanding this dynamic does not always lend itself to quantitative methodologies or evaluation metrics.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 2 Landscape Architecture, Urban and Rural Planning

Unit of Assessment: 636_3 Planning Research and Urban Theory

B 1. General assessment of the Unit of Assessment

The UoA has a mission to generate new knowledge within planning and urban theory, contributing to sustainable development according to environmental and social goals. The unit aims to be a meeting place for different aspects of planning research and urban theory, with links to planning practice. There is an emphasis on knowledge building and dissemination to encourage greater adoption of landscape considerations in planning processes at local, regional, national and international levels. Unifying themes in the research are reported to be formal and informal practices in relation to spatial planning processes and the everyday use of and human perspectives on urban space. Methodologically work ranges across the arts and humanities, social science and natural science, which makes it unique compared to other research environments for planning and urban studies.

This mission and approach are commendable but we were not entirely convinced that the strategy of the unit is suited to achieving this. The work appears fragmented and lacking in cohesion and direction. It also is reported to be driven largely by teaching and, to a lesser extent, practice. Although there were reported to be links with other similar units (such as Landscape Analysis and Planning and parts of Landscape Architecture at Uppsala, we found little evidence of this in the self assessment. We were convinced that there is a need for much greater collaboration between these different groups, perhaps under the umbrella of some form of overarching research grouping focused around landscape research.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria – *Research*

1. Scientific Quality

This group consists of two full-time full professors, who are mainly active in research, two senior lecturers, who are heavily involved in both teaching and research, plus one researcher and three PhD students. We met only one member, a senior lecturer, and did not have the opportunity to meet either of the two professors, which was perhaps regrettable. We reviewed the publications produced by this unit, including those provided in the original self assessments and those in additional lists provided at the time of the presentation. There are several good quality refereed journal papers in journals that are important in the field. There are also some novel and interesting research areas being pursued in the group and we believe that at least some of the publications have international recognition. The bibliometrics, although of limited value because of small numbers, show some evidence of a good level of citation. The papers on landscape and well-being were viewed by the panel as especially notable. Research funding has been modest at between 1.4 and 3.3 million SEK over the last three years, with these funds coming primarily from research councils and also from Swedish Public Authorities.

Overall we judge the scientific quality of this group to be internationally recognized.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The self-assessment document offers relatively little evidence about recognition and leadership. We were told that the research of this group is driven mainly by teaching, especially through working with MA students, and also to a small degree by the needs of practice. We did not get the impression that this group of researchers are necessarily seen as leaders in their field in terms of agenda setting, major commissions and overall visibility. We note the involvement of the group in the Nordic Research School for "Architecture and Planning for the Urban Landscape", which is common to other groups at Alnarp, and recognize that this is an important part of new measures taken to create an attractive research environment. Nevertheless, we concluded that on the basis of the evidence available to us we could only judge this unit of assessment to be inadequate in terms of recognition and leadership and scored it accordingly.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Even though this UoA seemed a little bit disorientated and lacking in overall direction and strategy, the impact of their work on the society was deemed as being of high importance. This is due to the fact that the UoA has managed to develop tools that are being used in large public bodies, such as Stockholm municipality and the Regional Road Administration. The 'Balancing – Method for Environmental Quality' is an example of this type of work. The UoA are furthermore frequently invited to be speakers in seminars and workshops and to act as advisors in planning projects. We also commend the group for trying to make clear links between the research, teaching and practice parts of their work, which is especially important in landscape architecture.

The relevance and impact is judged to be of high importance at the **local and national level** and temporally to contribute to a **short to medium term** perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

We found that, although there is good work going on in this group, there is also a lack of cohesion and an overall vision for the subject area and few clear links between the different

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

areas of work. The self-assessment concentrates on planning theory and interdisciplinarity in the section on strategy and potential, but does not give particular emphasis to the landscape dimensions of planning even though the senior members of the group are predominantly landscape architects. The presentation attempted to provide an overarching framework to link the work areas together but we did not sense that this represented an overall shared strategy for future research directions. The most tangible part of the strategy for the next five years is to achieve more frequent publishing, with a target of eight peer-reviewed articles to year for the unit as a whole. While this ought to be achievable there is little real discussion of how the greater focus on publishing is to be achieved in practice. The presence of three PhD students is encouraging but we had some doubts about overall strategy and potential for the future. Overall, we judged this aspect to be good.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The unit has no current involvement in FOMA activities. It may have the potential to become involved but this is only likely to happen through joint working with other related research units.

B 4. Actions for development at the Unit of Assessment

The unit has suggested that it needs one or two faculty positions to guarantee a long term strategy, as well as more international research exchanges. However, in our view, there is a need for a much clearer strategy for the overall direction and emphasis of the unit's research and also for close examination of the way that the unit is, or could be, linked to several of the other units at SLU which include landscape architecture and landscape planning. If this can be achieved then additional appointments could be made that are specifically aimed at reinforcing targeted research areas.

B 5. Additional information

We were struck by the fact that landscape architecture is represented by so many different research units in the current SLU structure. Although it is difficult for us to gain an understanding of the relationship between these groups in a short and visit and with only limited background information, we were struck by the similarities between the work taking place in different units. For example the work in this group on the subject of landscape and health has close links to the work in the Environmental Psychology unit on related issues of environment, health and well-being. Similarly there is work in the landscape planning field in another unit at Alnarp (Landscape Analysis and Planning] as well as in the Landscape Architecture units at Uppsala, especially relating to spatial planning. While recognizing that there is already some reported collaboration, and acknowledging the difficulties inherent in split site locations, we are convinced that there is a need for much greater collaboration between these different groups, perhaps under the umbrella of some form of overarching research grouping focused around landscape research.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Planning

Unit of Assessment: 636_4 Landscape Analysis and Landscape Planning

B 1. General assessment of the Unit of Assessment

This unit is one of four in the Landscape Architecture Department at Alnarp. It is focused on highly topical and significant research areas. These relate to future landscape transformation and in particular the development of tools that will assist in planning and managing landscapes in the face of globalization and urbanization and in anticipating changing patterns of land use and of production and consumption. This requires the researchers to address difficult questions about multi-functionality, ecosystem services and the values that society attaches to different landscapes. There has been a particular focus on the issues that arise in peri-urban areas where the unit is acting as a bridge and a focal point for PhD research at SLU. There is also growing emphasis on the evolving policy context provided by the European Landscape Convention.

We were impressed by the vibrant and enthusiastic presentation given by this group. They are a small unit with (as yet) no full professors. But all of the group members are active researchers and are publishing in the refereed Journals that are important in this area. They are also actively collaborating both within their Department and elsewhere at SLU. They are engaged with stakeholders and have a clear strategy for future research themes. At the same time they are making strong links between their research and teaching and are also the only unit in Landscape Architecture to have actively engaged with environmental monitoring through FOMA. Although this is recent they have already had success in gaining funding for projects starting in 2009 and have a clear strategy for more applications.

Our scoring recognizes these strengths.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The group consists of eight people accounting for 5.6 FTE, of which 1.8 FTE are senior staff and 2.3 are junior staff, plus a part time PhD student and a technician. Two have recently been promoted to associate professor, and two have docent competence, both of which we assume to be a mark of achievement in academic careers. Two more are expected to be promoted in the new future. They are involved in a number of interesting research projects and based on these have generated regular publications in refereed journals. A total of 18 refereed papers have been produced between 2004 and 2008, with the majority of them in journals which are internationally important in the landscape field (Landscape and Urban Planning, Landscape Research, Journal of Environmental Psychology, Environment and Planning B) of rapidly rising importance in the field (Urban Forestry and Urban Greening) or

important interdisciplinary publications (such as 'Perception'). This is one of the very few units seen by our panel to have an above average bibliometric profile. In addition to active publishing the unit has several active collaborations with overseas universities. External Research funding has consistently exceeded 2 million SEK in each of the last three years. Overall therefore we judge this unit's scientific quality to be 'high international'.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The notable point about this group is that their research focus has been developed from the grass roots – that is to say by the researchers themselves, without research leadership from a full professor. Combined with the relative youth and enthusiasm of the members and their desire to reach out and create links and networks both inside SLU and in the international research community, this suggests that they are becoming well recognised and demonstrating quite strong leadership in their area. They have been invited speakers at several conferences and organised a major and successful European (ECLAS) conference at Alnarp in 2008. They are actively involved in a number of appointments with European groups and committees, have actively engaged with public authorities and been involved in supporting policy and practice through training and development of methods. Taken together we concluded that these indicators mean their recognition and leadership is good with potential to become excellent.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Being new and relatively young the UoA is still in the process of building up their work and their profile and trying to put all the separate pieces together. However, they have already been very successful in this and are already highly productive and having a large impact on society. This is illustrated for example by the fact that they have been involved in developing recommendations to the Nordic Council of Ministers, and contributing important work in helping to evaluate and develop the planning process for wind energy in Sweden. Their relevance and impact is therefore judged as of high importance.

The relevance and impact is judged to be of high importance at the **Nordic and European level** and temporally to contribute to a **medium term** perspective.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The Unit's strategy for the future is driven by a recognition of the big global drivers of land use and landscape change such as climate change, energy strategy and urbanisation, especially in the peri-urban fringe. They also recognise the potential significance of the European Landscape Convention which is likely to be implemented in Sweden and have an important impact on research directions in landscape planning. They stress the importance of nurturing international collaborations and have identified and begun to implement methods of achieving this. They have already demonstrated that they can achieve their goals and have the potential to produce really excellent work.

Overall we therefore judge the unit's strategy and potential to be very good with many opportunities for future development of what appears to be a realizable strategy.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

This is one of the few units our panel met who were actively engaging with FOMA monitoring work. They have recently become, since the beginning of 2009, through the "Built Environment" programme and has three funded projects already. They also intend to become involved in other programmes such as Forest, Climate Impact, and Agricultural landscape and the upcoming Mountain areas programme. Their special competence in landscape planning and social and cultural evaluation of the landscape could, when applied to practical monitoring problems, make a valuable contribution to SLU's FOMA activity. These issues are likely to become even more important with the implementation of the European Landscape Convention which Sweden is believed to soon ratify. We cannot comment on the quality of the work as it has only recently been commenced but there does seem to be high potential here and the unit should be encouraged to engage with other FOMA participants at SLU and to develop its potential role in the various programmes.

B 4. Actions for development at the Unit of Assessment

The majority of the staff in the unit is relatively new arrivals at SLU but two have been at the University for a longer time. Most rely heavily on external funding and so must spend a great deal of time preparing bids for research and project funds. They would benefit greatly from more certainty in their funding and more technical and administrative funding for their work. Although there is no full professor in the unit this does not so far seem to have held them back and so we do not think it is necessary to add new senior posts, but rather to encourage the existing staff to feel more secure and to ensure that they are retained at SLU

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

This unit is closely related to the Planning Research and |Urban Theory Unit in the Department of Landscape Architecture at Alnarp and we were advised that the groups do work together. There might have been merit in presenting the two in a combined unit. Certainly we urge as much collaboration as possible and the development of a stronger identity as a research cluster in landscape planning. There is also scope for this cluster to embrace (intellectually not geographically) the spatial planning researchers in the landscape architecture unit at Ultuna. This is an increasingly important research area and critical mass of academic staff and Ph D students will be vital to gain the international profile that the work deserves. The clustering of such researchers under the umbrella of an overarching centre for Landscape Research would be beneficial.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 637_1 Landscape Development with a Social Science Approach

B 1. General assessment of the Unit of Assessment

This unit is a new group combined from two other units in 2007 from largely teaching based departments. It is a group with traditional strengths in landscape architectural design, construction and management. It includes two Professors, two Senior Lecturers, several support staff and four PhD students. External funding is relatively small at a level of .1 to 1.9 MSEK a year with Formas funding of 4.7 MSEK. The unit's focus is on traditional open space spaces such as gardens, parks and streets and they are well known for this work in Sweden. They are in clearly still transition as a result of the new reorganization moving from a practice-based focus to more of a research-based and publication driven culture. There is a close relationship of research to teaching in this unit as its faculty expertise is in design and management of the built environment. With large numbers of students and heavy teaching loads, this poses a challenge for this group as it strives for research productivity and excellence.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The stated research focus of this unit is on landscape technology and user participation in landscape management with a special concern for residential landscapes at the site or housing development scale. They have a good relationship with local communities and do research that is more of a case study nature. The unit reports that its research activities to date “have been of a relatively limited scope and have mostly taken the form of short practice-related projects with the aim of solving problems relevant for the sector”. Publications during this review period have been published in journals such as Landscape Research and Children, Youth and Environments, respected journals in the areas of landscape architectural and child-environment research. They range from 0 – 2 refereed articles a year, relatively few publications to date, a situation the group is working to correct. Only one PhD dissertation was produced during this period. They attribute this low volume to “staff involvement in undergraduate education”.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

This unit has a well-established relationship with local and government officials and is well known throughout Sweden for their applied projects and technical assistance. They also are well known in Europe for the work on nature-based landscape design and the relationships of plants in the urban landscape, although this was not highlighted in the materials presented. They describe their research as “a clear emphasis on end benefit”, research that is typically need driven. While this work is meritorious, they need to also engage in studies across a wider range of cases and projects with a focus on comparison and utility for landscape designers and managers. To be more productive in research output, this group needs additional expertise in environmental design research and a better balance of time between undergraduate teaching and research. The group has recently completed a major revision of their curriculum and courses that may free up time for more focused research.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

This unit presented academic interests and working processes for landscape development and management and report a strong relationship with industry. This was, however, regarded as having just a moderate impact on the society. This is mainly due to the fact that the UoA has not produced very much research that is of direct use to stakeholders, at least evidenced by the materials provided. Furthermore, the unit did not put much focus on outreaching activities and could not be regarded as having more than a moderate impact on the society. The “large proportion of research projects” they mention in the Self Assessment was not clearly evident in the material presented or at their webpage.

Regional/national; Short and medium term

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Their research focus on user involvement in landscape management is a topic of expanding interest and relevance in Europe and internationally. They would also like to expand their research efforts in sustainable urban landscape management, a topic of critical importance. We see great potential in these areas of work and encourage the unit to expand its efforts in these new and emerging areas of landscape architectural research.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

No environmental monitoring and assessment

B 4. Actions for development at the Unit of Assessment

This group would like to expand the number of PhD students to two per year and appoint a senior leader with social science expertise to advance their work in this area. We see limited potential for this unit to develop their stated research objectives alone and urge them to link up with other researchers both at Alnarp (such as in environmental psychology) and Ultuna (in landscape architecture and community development) to maximize their impact in this area. They can also involve themselves in studies outside Sweden and better collaborate with international researchers through organizations such as the International Association for the Study of People and their Physical Surroundings (IAPS) and the Environmental Design Research Association (EDRA).

B 5. Additional information

This group, while small and just beginning its research efforts, has the potential to have a strong impact on research in landscape development and management. Through research collaboration with other units in SLU and other researchers outside Sweden, there is the potential to develop excellence in research on user involvement and human dimensions of designed landscapes. Yet some umbrella organization is needed to facilitate this such as our proposed Centre for Landscape Architectural Research (CLAR) as outline in our summary Report A.

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 638_1 Work Science

B 1. General assessment of the Unit of Assessment

The Work Science unit has a clear applied science or need driven profile. It is a relatively small unit comprising of one professor, three researchers, two lecturers and two PhD students. Central focus has been – and is still to a large extent – injury prevention and ergonomics in agriculture. In addition the UoA wants to engage more in research focusing on work psychology & leadership and working life development.

The faculty and department reform 2007 has opened new opportunities for the unit to collaborate especially with business economy and environmental psychology.

The overall picture is of a rather well focused, quite specialized, need driven research group with an important mission to increase the understanding of causes of injuries and poor ergonomics in agriculture and thereby actively bring about changes that will enhance safety and health in agriculture including nearby industries.

The UoA has a vision to broaden its focus from agriculture to “the green sector & the food-chain” at large as well as doing more on working life and leadership more generally. The strategy how to accomplish this broadening of the research area is not convincingly formulated in the document. We are commenting more on this issue down at B.4 (Strategy and Potential).

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA has published reasonable well in international peer reviewed journals (ca 2/year) taking into consideration the size and the relative applied research character of the unit. Numbers of reports and conference proceedings has increased considerable during recent years. Just one dissertation (2008) is reported for the 2004-2008 period which can be seen as a consequence of the fact that “work science” is not a subject area in the programs at Alnarp and that recruitment of research therefore is not self evident. The unit is well recognized at a Nordic level and had a leading role in the adaption of a Nordic (Kuopio) declaration against fatal injuries in agriculture. The unit has increased considerably its external funding for research, which must be understood both that there is a need for this sort of research as well as an acceptance of the scientific output. The external funding ratio 2008 was 82 %. There is few signs of a broader social science / sociological approach.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA has apparently a well established position at the national level and is also recognized at a Nordic level. The unit has the ambition to establish a Nordic Competence and Learning Centre in its field of research. The panel had not enough information to critically assess the realism of this plan. (see also 4. Strategy and Potential concerning the idea of a Nordic Centre)

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA has an important role within its field to reduce injuries and hence enhance security and wellbeing in agriculture and its immediately technical surroundings. The size of the unit is quite small and its capacity to move into a broader field of research concerning working conditions, not only in agriculture, but also in so called “new rural goods and services” is still limited.

Our view is that the UoA has a well established position at the national and Nordic level in core areas of research, while more general international cooperation still takes place at a quite low level.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

In the self assessment the UoA mention the lack of “critical mass of people” as a weak point. At the meeting with the panel, the UoA personnel considered the reform of departments and faculties two years ago as a positive change; that the new (department) structure has opened new possibilities for the Work Science unit to strengthen its position, to collaborate with the units of economics and environmental psychology, and to get recognition within SLU. Still, the goals and strategy set up, is quite ambivalent. On the one hand, there is the interest to broaden the spectrum of research from mainly ergonomics and injury prevention in agriculture to a broader scope of “the green sector & the food-chain”. Some of the themes by PhD new students employed exemplify this broadening perspective. On the other hand, most suggestions in the A5 section, Strategy and Potential, underlines the core, “traditional” field of research: development of an international milking ergonomics project, EU projects on ergonomics, evaluation of the national injury prevention program, further development of the collaboration with Swedish Institute of Agricultural and Environmental Engineering. The

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³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

objective to establish a Nordic Competence and Learning Centre focusing on rural health and safety could be a broadening of the research area (“rural” instead of “agriculture”) as well as some other collaborations including “health” instead of just injuries in agriculture (which in itself is of course a severe issue).

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

In order to fulfil its ambitions to broaden its research field the UoA should seriously seek cooperation with social science departments outside SLU with work science / sociology of work on the agenda in order to move beyond the core area of injury and ergonomic research.

B 5. Additional information

If the plan to establish a Nordic Competence and Learning Centre focusing on rural health and safety can be realized, we recommend co-operation with some social science unit (in the Scania – Copenhagen area) from the outside of SLU in order to strengthen social science competence.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 638_3 Environmental Psychology

B 1. General assessment of the Unit of Assessment

This is a comparatively young research unit with 7 PhD students (some of whom are also lecturers), four senior researchers and two professors, only one of which is full time (one is at 40%), as well as 5 therapists etc working in the Alnarp Rehabilitation Garden. The area of research is environmental psychology with a focus on experience of and preference for landscapes. Preference studies draw on an established tradition of research in this area to explore how people experience the outdoor environment in terms of experienced characteristics, biodiversity, qualities concerning play activities, social activities, etc.. Health promotion research builds on a major theme of the relationship between access to green spaces and people's health and well-being and involves epidemiological studies, GIS and planning of green structures. The unit is also developing a growing body of research in preventative healthcare, with particular attention paid to children's outdoor play environments and outdoor spaces for elderly people in long term care homes. Another major area of research, and one that is receiving particular international interest and acclaim, is the unit's work on therapeutic landscapes, using the Alnarp Rehabilitation Garden. There is also an area of more curiosity-driven, fundamental research on landscape cognition, emotions, sense, etc., and work on the importance of enriched environments on people's salutogenic capacities.

All of this work involves lively interdisciplinary research and collaboration between landscape architects and planners, environmental psychologists, sports scientists, behaviour scientists, geographers and GIS specialists, epidemiologists, etc., both within SLU and beyond. The unit engages with other universities, both locally (in the Alnarp/Malmö/Copenhagen area), as well as internationally, e.g. with UK, USA research centres. The unit is impressive in what it has achieved with a comparatively small group of researchers who appear to be innovative, energetic and well respected by their peers.

Engagement with FOMA is new but shows potential to make a valuable contribution.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Bibliometric data is difficult to assess because of the comparatively small group and doesn't necessarily capture the full impact of the research in this unit, where landscape architecture, for example, is poorly served by conventional citation measures. The unit undertakes

curiosity-driven and needs-driven research, both to a level that is of high quality and, in many cases, internationally recognized and potentially world-leading. Their publications include papers in highly rated journals, for example, *Preventive Medicine*, *Journal of Epidemiology and Community Health*, and *Urban Forestry and Urban Greening* (newly established but with rapidly rising impact).

The academic networks identified in B1 are strong and successful in supporting scientific excellence at the local level while also ensuring engagement and collaboration with leading researchers and groups in the international research community. The external research grant income is good, with a notable increase in 2008.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Expert membership of COST Actions by Grahn and advice to the Nordic Council of Ministers by Grahn and Mårtensson confirm these researchers' international standing and recognition. In addition, there are four awards, some international, for Grahn's work. The group has had an impressive number of national and international invitations to speak at scientific conferences in the last 5 years, suggesting a significant impact on the wider academic community and society.

The national and international academic standing of the group is also reflected in the number of research students at present -7 PhD students (we understand that the data in the self-assessment is inaccurate in this regard). The staffing profile is healthy, with 6 new recruits since 2006 as well as senior level academics and opportunities for high level career progression beyond the SLU, e.g. one senior researcher (Stigsdotter) recruited to become a research director at the University of Copenhagen in 2007 (although this is a loss for the SLU unit).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Research in environmental psychology and the research of studying people's preferences of different environments are of high relevance to the society. How people experience biological diversity is becoming more and more important in urban and rural planning, and the research undertaken by the UoA is regarded as important and successful when it comes to both relevance and impact. The ability and potential to contribute to the development of the society are regarded as high and therefore the research performed by the UoA is recognised as having High importance. This is due to the importance of the environment's influence on human wellbeing and the way the UoA undertake their research. There are some important and successful co-operations with the society (e.g. larger Swedish companies, institutes, etc.) and

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

the will and objectives of the UoA to further develop these, e.g. through building 4 rehab-gardens in the Netherlands together with PresEarth, are regarded as promising.

Nordic/European but with potential for global
Long-term

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Their strategy is ambitious and exciting and their record gives confidence in their potential to succeed. The gender balance seems appropriate. They plan to develop evidence-based design and planning guidelines for green structures in urban areas, with special attention to design for children and for older people. They are working to develop intervention and epidemiological studies on the health impacts of access to green areas, including study of the associations in relation to diseases such as diabetes, cardiovascular disease, etc.. They will also continue their important work on nature-assisted therapy and therapeutic natural environments. Although they already have a good publication record, they plan to enhance that with papers in scientific journals with an even higher impact, especially health-related journals. In addition, building on their international networks and collaborations, especially beyond the Nordic countries, will enhance their profile and allow them to engage in internationally leading work. Their research will contribute to widening the concept of a sustainable society, involving ecology, psychology, sociology and health in building cities of tomorrow.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA has no FOMA projects of its own. The FOMA activities of the UoA are restricted to methodological input regarding experience values in urban green open space. They participate in a NILS monitoring project, funded by the Swedish Environmental Protection Agency and with its base in The Department of Forest Resource Management, SLU Umeå. As this is a very new activity, no results as such have yet been produced. However, this is a valuable and important contribution to widening the concept of environmental monitoring in relation to human health. The Swedish Environmental Protection Agency, and probably other authorities within housing, health and culture, will benefit. This is one valuable way that the research of this unit can have an impact on society and influence stakeholders.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The unit already has a good vision for its strategic development and how to achieve its aims, so there is comparatively little to add here.

While pursuing high impact journals, the unit should also remember the value of publishing in mainstream environmental psychology journals and landscape/environment academic and professional journals, so that the planning and design professions benefit from the important research findings.

The Alnarp Rehabilitation Garden is an important facility that provides a rare opportunity for researchers to undertake longitudinal work on green environments and health in quasi-experimental conditions. The unit is unique among researchers currently exploring such links world-wide in having access to such a facility, and the garden is thus a vital part of the research environment, equivalent to the laboratories of more traditional science. Its development and maintenance must be supported by the SLU if the important work of this unit is to achieve its full potential.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 2. Landscape Architecture, Urban and Rural Development

Unit of Assessment: 924_1. Sustainable Food Systems

B 1. General assessment of the Unit of Assessment

Research on organic farming and other models for sustainable agriculture is fundamental for future food production and environmental stewardship. SLU has the capacity to lead nationally and internationally in this area due to the blend of natural and social science expertise available together with real links to stakeholders in the food and farming industry. However, CUL (the centre for sustainable agriculture at SLU) currently has no mandate for research. Without a mandate for research the UoA does not have the necessary academic standing to initiate and conduct a robust programme of research, with the attendant senior staff and PhD programme. The current staff are enthusiastic and able but lack the breadth of expertise needed to meet the UoA's interdisciplinary aspirations. The UoA is in a period of uncertainty due to a very recent review within the Faculty and the recent resignation of the Director of CUL. We are aware that one possible resolution to this issue is to make CUL a specialized centre for knowledge transfer and exchange related to organic farming. We support this as it separates the issues of promotion of organic farming to support the Swedish government targets from independent scientific research. The applied research currently being carried out within CUL is important and could be relocated within the Agroecology Unit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Research within the UoA covers a diverse range of topics related to sustainable food systems. A wide range of research approaches is also represented, this includes different scales e.g. process based soil-plant interactions through to biodiversity the landscape scale and traditional replicated natural science experimentation through to participatory approaches. Much of this research is published in appropriate journals. The UoA has been successful in getting competitive national research funding but has no PhD students. There is currently no mandate for research.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA has national recognition in relation to applied research e.g. members of the grant awarding committee of the Swedish Farmers Foundation. There are also good links into national organic farming bodies and other sectors of the agricultural industry in Sweden. The Unit has also been active in facilitating research schools in organic farming in Sweden. Leadership is greater in relation to the practice of organic farming and in national education programmes than in international research.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The relevance of the research area is undoubtedly very high, but the impact of the research done by the UoA does not fully realise this potential. The research done by the UoA is, however, regarded as interesting and includes some highly relevant and promising ideas, and even though the UoA is not regarded as an cutting-edge research team, their influence on society is regarded as being of High importance. However, connections with the food industry seem limited and there does not appear to be a coherent plan for increasing this substantially. The UoA gets asked to work in consultation processes and have initiated a centre of sustainable agriculture (CUL), which is evaluated as an interesting “invention” with potential. It produces a series of synthesis reports of national importance, and has a clear role in organising conferences and events. CUL implies therefore an interesting opportunity to work in an efficient and productive way with the society and stakeholders. The definition the UoA used for ‘sustainable’ was however not very clear and could preferably be discussed further, decided on and communicated more efficiently.

Geographic (b) Nordic/EU

Temporal: Research areas relevant to all timescales a: short-term; b: medium-term; c: long-term perspective

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

At the present time there does not appear to be a clear strategy for future research in terms of the main scientific questions to be addressed. If the UoA had a clear mandate for research then a strategy would need to be developed. Thought needs to be given to the possible tensions between the knowledge transfer remit of the centre and any potential research remit.

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

This is because the UoA is being funded to help deliver Sweden's political goals for organic farming and this could conflict with the ability of the UoA to carry out robust, independent research on sustainable agriculture. The UoA needs senior level leadership, a research mandate and direction if it is to lead internationally in research in this field. The panel are not convinced that giving a research remit to CUL is the most appropriate mechanism for developing research on sustainable food and farming, including organic production at SLU. See comments above.

On the basis of this evaluation, award a score from 1-6⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

N/A

B 4. Actions for development at the Unit of Assessment

The suggestion that CUL should not carry out research in the future is not a reflection on those currently carrying out research within the unit. Most of these researchers have disciplinary 'homes' elsewhere in SLU, however, it is important that these researchers are allowed to continue their research within an inter-disciplinary environment supportive of systems research. There is valuable ongoing applied research in a number of areas including climate change, food production and distribution systems and system resilience.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 3. Ecology and Environmental Sciences

SLU hosts one of the most powerful and extensive groups of ecologists in the world. Much research conducted by the ecologists is cutting-edge science being published in the world's leading scientific periodicals. This research is distributed across a number of departments and units of assessment, with staff in Umeå, Uppsala, Grimsö, and Alnarp. We see opportunity for Sweden to continue its strength in ecological research and to improve in a number of areas. The strongest programs among the 11 units of assessment that we reviewed were: (1) Forest Vegetation Ecology, and (2) Wildlife, Fish and Environmental Science, both in Umeå. These units both contained a critical mass and breadth of scope combined with outstanding leadership that made them stand out as truly superb. Another smaller but highly productive unit is the Systems Ecology group within the Department of Ecology, but we are concerned that the small size of this UoA renders it unstable. Indeed, the small size of several of the UoA's on the Uppsala campus threatens their viability. Specifically, we believe that the units of Landscape Ecology, Population Biology, Conservation Biology, and Ecotoxicology should explore options to combine and focus their research to strengthen and stabilize the units and to reduce redundancy. For example, we recommend that the Population Biology unit in Uppsala should be combined with the Wildlife Ecology group in Grimsö to stimulate interaction between applied and theoretical approaches.

Two units that we reviewed are not truly research units: NILS and CBM. Although these units provide support for research and monitoring, they do not have a clear research mandate. The landscape inventory program (NILS) is relatively new but there are opportunities to analyze spatial structure of the data collected thus far and as data accumulate over time, additional research opportunities will become apparent. Yet, there is no particular reason that research should be a mandate to the monitoring team running this program. The Biodiversity Centre (CBM) provides service by communicating information about biodiversity and ethnobotany to Swedish stakeholders and the public. Like NILS, this is not truly an academic unit and it is not clear that it should be charged with a research mandate. Indeed, given the need to communicate effectively with the public, we think that CBM is performing a valuable function. Combining NILS and CBM would benefit both units and the synergies would promote extension and service functions for SLU ecologists.

Several units acknowledged a weakness in mathematical modelling and quantitative science. The Systems Ecology UoA has strength in modelling but this is highly specialized and not likely to support other UoA's. Resolving this issue should include several approaches including undergraduate and graduate education, hiring new maths/stats staff to collaborate with existing faculty, and ensuring quantitative strength in new staff appointments.

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 241_2 Forest Vegetation Ecology

B 1. General assessment of the Unit of Assessment

The 'Forest Vegetation Ecology' UoA focuses on a better understanding of biotic and abiotic drivers of forest ecosystems, including interactions of plants with other aboveground and belowground organisms, relationships of plants with extrinsic disturbances such as fire and the role of historical factors on forest processes. A wide span of issues is covered. About 70% of the work is done in the Swedish boreal forests, the rest in forested systems abroad. The overall impression is one of excellence. This unit starts from a sound conceptual framework with strong interdisciplinary research; it shows continued hard work on incorporating young talented people into its research and it has a tradition of close cooperation with stakeholders. Despite the success, the unit leaders remain critical and open for discussion. The unit selects for quality rather than quantity. Other units e.g. 295_4 (Forest history & forest vegetation ecology) would benefit from the overall scientific quality of this group and the conceptual framework in particular. A fusion of the two would also have the advantage that the dominance on boreal forests within 241_2 would be broadened to all major forest types. The panel shares the concern within the unit 241_2 that essential competence is at risk even if one key-person would leave. Particularly, post-docs are underrepresented and there is some concern about the gender issue, particularly in terms of successional planning – an issue which is not only a concern for this group but for also for many others in forest science and beyond.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This unit shows an outstanding combination between curiosity-driven and needs-driven research. It marvelously manages to implement demands-driven research into a scientifically conceptual framework. The panel was unanimous in recognizing it as a world-leading group, with excellent, highly cited and recurrent publications in leading journals. Both geographical scope and academic networks are excellent. The number of PhD students is significant, yet it could be higher. This had more to do with the fact that PhD students are rather expensive and that funding is only available for 3 years when it often takes 4 years to complete an ecologically oriented PhD. Although a possible problematic point, the unit makes this a strong point, as fewer students will be better supervised, publish well and easily find their way into the job market.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Through its frequent publications in leading journals this unit surely is widely recognized and an active policy of recruitment of both staff and PhD students is in place. Extensive renovation and new lab facilities have created an attractive research environment. PhD courses attract applicants from many countries. Post docs are actively trained and involved in externally funded projects. Several researchers have received major awards. Involvement of stakeholders in masters & PhD research projects and even in scientific output further creates a clear visibility in society. Therefore the panel gave this unit the highest possible score (outstanding).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Although the research starts from a clear conceptual framework and is of fundamental importance, the unit has managed to keep its science highly relevant to society in particular to the management of boreal forests. The development of courses particularly oriented at forest managers, the involvement of stakeholders in the scientific work, research conducted at archaeological sites, and research on ecosystem impacts of invasive animals (N. Zealand) stress the relevance for society. Forward planning has allowed this UoA to strategically select projects and contracts for the coming years.. The panel therefore again assigned the highest score of 6 for this criterion.

Relevance not only has a national but also a Nordic & a subglobal dimension. And as research focuses on processes it is clear that it has high importance on all time scales.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The potential is very clear and already visible, as projects for the coming years are already in place. The unit is in terms of size manageable and quality is preferred above quantity. The gender balance could be better (see B1). But this is not related to the policy of the unit. There are clearly sufficient female students, but successional planning within this research field remains difficult (not only in this unit).

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The strategy the unit follows is realistic, there is a steady implementation of a strategic plan (excellence in science, collaboration with both scientific community and stakeholders, gradually incorporating new ideas and new research) The panel unanimously gave a score of “outstanding”.

On the basis of this evaluation, award a score from 1-6 ⁴:

6

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

From the available expertise in research and collaboration with stakeholders FOMA projects will be in good hands.

B 4. Actions for development at the Unit of Assessment

It is difficult to improve; a continued or even strengthened policy to attract young people in research both from inside and outside the country, an active gender policy are perhaps the most important things to work on. FOMA activities are considered important.

B 5. Additional information

Other units e.g. 295_4 (Forest history & forest vegetation ecology), working in clearly related fields, would benefit from the overall scientific quality of this group and the conceptual framework in particular. A fusion of the two would also have the advantage that the dominance on boreal forests within 241_2 would be broadened to all major forest types. Keeping good collaboration with CBM remains important.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 251_1 Wildlife, Fish and Environmental Studies

B 1. General assessment of the Unit of Assessment

This UoA was particularly impressive in terms of its recognition both within the wildlife and fish research communities and in terms of its interactions with stakeholders. It engages in a multi- and interdisciplinary approach with regards to its activities incorporating economic and social science expertise. There was clear involvement in research and education in developing countries that impressed the panel.

The fusion of two previously separate units, one based on wildlife and the other on fish, was seen as an important and successful strategic move. It appeared to have resulted in the break down of barriers and the successful merger of approaches, which in some ways were artificially separated along taxonomic boundaries. They are unified in their approach to the management of exploited game and fish populations, which are of notable cultural significance in the Swedish landscape. The fusion approach contrasts to some extent with what was seen in the Department of Ecology, where smaller units had been formed (splintering). The larger unit here, appeared to benefit from the cross fertilization of ideas, greater stability/resilience simply due to their larger size and a unified, collegial atmosphere. Key research areas spanned the taxonomic barrier, such as dispersal, migration, life history strategies, population genetics, parentage/pedigree analyses and population dynamics; all under the umbrella of sustainable population management. The leadership shown in this group is very evident and reflected in the unit's strength.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific output of the UoA is internationally recognized, particularly as evidenced by a number of important publications of the wildlife group (e.g. in *Nature*, *Ecology Letters*, *Ecology*). The panel felt that the general approach used of investigating the particular fish and game organisms from the biological to the social science perspective was strong in providing critical information for sustainable management. An explicit presentation of the theoretical foundations upon which the work was based, however, was lacking somewhat. Common themes to issues such as migration, foraging behaviour, landscape interactions, human disturbance were identified, but the theoretical underpinnings to the approach to these issues were not as well defined.

The choice of methods was highly relevant, and showed that the unit is using some of the cutting-edge technology to their advantage. Combining telemetry with parentage and pedigree analyses provides powerful tools for the study of the dynamics of game and fish populations, particularly in light of harvesting and other human disturbance.

The breakthroughs reported by the unit were general, and lacked specifics. This, however, may be more a reflection of the breadth of their work rather than the lack of any specific breakthrough.

A strength of the unit was its ability to combine high quality basic and applied research. They are at a high international standard and broadly recognized for their work in particular areas. The unit has numerous collaborations, outstanding in fact, from a regional to national to international scale, and crossing the boundaries of disciplines. The fish component of the unit is one of the most recognizable within Sweden for its applied research and has a number of external collaborations. The wildlife component is a true leader at an international scale.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The panel was impressed by the recognition and leadership shown by the unit and ranked it as outstanding. The wildlife component, in particular, is a leader in the scientific debate surrounding the management of boreal wildlife. They have also actively sought to extend their expertise to developing nations, not only in terms of undertaking research but in training scientists and managers in those regions. It was also evident that the leadership in the unit has created an outstanding environment for research.

Outreach by the unit was also similarly outstanding. They have actively worked with and engaged the user community, and included economic and social science aspects in their analyses. Both of the latter are of considerable importance in the management of exploited species, which are also of significant cultural importance.

The unit has been proactive about recruitment and involvement of PhD students and postdoctoral fellows in its activities. The development of supervisor/support groups is seen to be an important avenue to increase PhD education. The students and fellows are seen as an integral part of the renewal and vibrancy of the unit, and the deliberate initiation of an international exchange assistance program is important in forging new ideas, collaborations and directions.

Outreach to government, inter-governmental organizations and non-governmental organizations is outstanding, particularly on the wildlife side.

This unit showed true leadership and had a defined and focused direction (e.g. unified through common programmes). They had undertaken a strategic, and what the panel believes has been a highly successful move to fuse two previously separate departments. This has promoted the high quality and relevance of the science being undertaken. It has allowed for the cross fostering of ideas and expertise.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The active engagement of user groups in the work and its outcomes speaks to the relevance of the research being undertaken by the unit. It was the panel's opinion that the UoA showed the ability and future potential for generating knowledge that is and will continue to contribute substantially to the sustainable management of wildlife and fish populations in Sweden. The problems addressed and the general approaches used were appropriate to the needs of society. Again, as mentioned previously, the engagement of economists and social scientists allows for greater engagement of society in the tricky questions that surround the management of common resources, such as wildlife and fish.

The unit actively reaches out to the user community, including forestry groups, hunters and fishers, and is probably one of the few units with a specific program to do so. The adaptive management research programme is a good example of how the group actively involves users. Reach of the unit beyond the borders of Sweden is impressive, with work occurring in developing countries where members of the unit have been involved in the training of 5 PhD and ca. 40 MSc students.

The geographical and temporal dimensions of the unit's work are impressive, particularly that of the wildlife component, from local to international, and from short- to long-term. The unit works on a number of long-term data sets that are invaluable to fish and wildlife management.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

A clear vision and strategy for the unit was communicated. This strategy is to continue to be a world class unit researching wildlife and fish resource use. A more explicit foundation in theory, however, might be useful and contribute to this forward looking program. The interaction and communication with stakeholders is central to the strategy and is a clear strength.

There is explicit attention given to the human capital of the unit and this was very evident to the panel. This creates a positive environment, fostering creative thinking and stimulating unit interactions. The unit appears to be composed of a good mix of senior and junior researchers, as well as PhD students and technicians.

A desire was expressed for increased modelling and statistical competence, and the panel agreed (a common theme across several of the UoA's the panel reviewed). The UoA also recognized the need for assistance with database management because of the ever growing size of the databases that the unit is operating with. With the addition of pedigree data, the panel sees this need as ever increasing in the future.

On the basis of this evaluation, award a score from 1-6 ⁴:

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

The UoA has FOMA responsibilities, (1) on wildlife and the other (2) on fish. The wildlife aspect involves collaboration with other groups at SLU including NILS, Department of Ecology and the Grimsö sub-unit. The UoA appears to have a central and important role in the development of methods for data collection associated with the monitoring programs. With regards to the fish FOMA activities, the UoA leads a counting program of migratory salmonids in select watersheds (e.g. River Sävarån), which is important in providing annual data to the Swedish authorities (e.g. National Board of Fisheries) and the International Council on the Exploration of the Seas (ICES) working group on salmon. The quality of these programs seems top notch and the UoA continues to think creatively about ways to improve the information gathered (e.g. use of genetic monitoring) and how it can be used to provide insight and predictions for managers. These activities are currently constrained by a lack of resources.

The FOMA work produced by the UoA appears to be trusted because of the view that it is an independent organization that does good work.

The unit may be considered exceptional, particularly on the wildlife side, in its ability to portray its relevance to end users. There is considerable effort placed on communicating with stakeholders and this appears to have been effective. The UoA has attempted to incorporate a truly adaptive management approach in its recommendations for the management of Swedish wildlife resources. It appears to be a national, if not European leader in advocating for such an approach. Moreover, the UoA has been effective in developing “symbiotic” relationships with hunters and fishers, involving them in data collection and providing analytical expertise for interpreting the data.

B 4. Actions for development at the Unit of Assessment

- A more explicit consideration of the theoretical underpinnings of the research
- Consider adding bioinformatics/modelling expertise to the group, either through hiring or alternatively, collaboration with an outside group
- Technical assistance with data-base management
- The UoA is exceptional in its communication with stakeholders and the research it is doing is of very high relevance
- The UoA's attention to attracting outside visitors is to be commended
- FOMA activities of the salmon group could be increased through the development of trapping facilities for returning adults
- Opportunities for sabbatical would be important for introducing new ideas and reinvigorating researchers

B 5. Additional information

- It was a strategic move to combine wildlife and fish, and has proven to be very forward looking
- It might be good to attempt to further foster communication with the wildlife and population ecology units within the Department of Ecology. There is considerable expertise in both groups and common interests.
- Engagement of economists and social scientist should be commended
- Similarly the engagement of stakeholders is exceptional and should be encouraged to continue (it is a model UoA in this sense)

Part B: Report on individual Unit of Assessment

Panel 3. Ecological & Environmental Sciences

Unit of Assessment: 260_7 National Inventory of Landscape in Sweden – NILS

B 1. General assessment of the Unit of Assessment

Monitoring is the primary mission of this unit. Research is a secondary mission. The unit delivers indicators for 10 out of 16 objectives put forward by the Swedish government. Therefore a huge data base is set up, collecting data on biodiversity covering the whole of Sweden. After 5 years the platform seems to be ready and a core set of variables is selected and a first monitoring round has been finished. Variables may be added in response to demands. The panel considers it extremely important that a core set of variables is monitored over a long period (at least 3 times, over a period of 15 years). About 120 5 x 5 plots are surveyed every year and all 631 plots are inventoried every 5 years. Set up seems to be carefully thought through partly in comparison with other countries and partly in comparison with the National Forest Inventory. Until now output besides regular reporting is extremely low. Given the primary objective, the panel felt it not (yet) appropriate to give a score in terms of scientific quality. The panel strongly supports the idea that monitoring should be combined with scientific research, as it will keep scientific competence. The needed external money could be obtained from scientific projects proposed by the unit perhaps preferably in combination with other relevant units/institutions. The coming decade will be crucial to show the potential in terms of applied research, although relevance and potential are already clear and considered highly important. Although recognition & relevance are high, a lot still needs to be proved. Basically it's too early to really evaluate this unit. Care should be taken that credits from scientific work based on data from NILS, should also be linked to this unit. An idea might perhaps be to consider fusion with 910_4 (Swedish Biodiversity Centre) and/or other related monitoring units.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The NILS program focuses on environmental monitoring and is mainly demand (in particular EPA) driven. It should basically provide a variety of data on biodiversity conditions and (in the long run also) on changes. It should deliver data and indicators for 10 out of the 16 national Environmental Quality Objectives.

Scientific quality in terms of productivity, traditionally looked at in terms of output, is - besides regular reporting – actually limited. Given their mission the score for this criterion cannot be high. The feeling is that NILS actually cannot be fit into this scoring system, therefore this criterion was not assessed (NA).

Although officially started in 2003, it must be emphasized that this unit is still in a refinement

phase. Five years have been largely devoted to the development of a sound methodology, a monitoring infrastructure and a reporting system; this seems rather long given the experience with e.g. the national forest inventory. However the choice of methods for setup and variable selection seems to be well argued and partly based on international comparison. The coming decade will be crucial for the unit to prove that they can add applied science. The geographical scope is definitely Sweden, but it might be reasonable to look for opportunities to expand it to Norway and/or join with other initiatives within the EU framework. Collaboration with other monitoring units would strengthen the unit and has been limited until now, although many EU countries, particularly those in the west, do have similar or related programs. The full scientific exploration of this highly important data base will only be really possible after the second round of data collection. For maximum performance a small team of permanent staff, a well managed & coordinated scientific network including other units (e.g. 910_4) in SLU and abroad will certainly help to explore the full potential of the data base. Together with a continued financing, it is the best guarantee for the continuation of NILS.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

NILS will only be really successful if it manages to be a fully operational platform for biodiversity (and related) data in relation to the demands of the stakeholders. Such an important monitoring scheme will deliver important data and derived indicators for both the use in scientific work and for the fulfilment of national and international commitments of Sweden. It may support policy development on the national and regional scale. A independent user committee might help to build up trust in NILS. Efforts to secure data collection and quality need to be continued. Results (methodological solutions) on the latter issues probably can be published in peer reviewed journals; it will help them to build leadership and strengthen trust in NILS. If NILS manages to fulfil this mission it will be recognized and visible in the society. It will also be attractive for the research community, particularly when several monitoring rounds will be finished. Currently it's too early to really evaluate the recognition and leadership. Therefore, a "moderate" score has been given. It is basically not needed that NILS has PhD students as long as its data are used in PhD and other scientific research. Good rules of understanding on the use of NILS' data are vital, so that credits not only go to the scientific community but also to this unit.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Given the emphasis on the sustainable use of our ecosystems, data indicating the state of the environment and the changes on both regional and national level are of vital importance. Therefore the panel considered NILS highly relevant to society in general. But as it still

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

largely has to demonstrate its potential for generating knowledge useful for a (more) sustainable development it was felt to score this criterion not higher than “highly important”. One suggestion might be to combine NILS with UoA 910_4 (and eventually other units monitoring environmental and biodiversity aspects). NILS collects, manages data on biodiversity, CBM has synthesis as part of its task. It will make both more visible.

Although initially intended for the national level, it is clear that the collected data will be useful also for the regional level. If incorporated in or linked to a Nordic and EU context it will also be more valuable and impact would be greater. Ideas to expand it to the municipality level are actually unsure and need further investigation. The time perspective is, given the necessity of 5 years for a full survey, inevitably at least medium termed.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Although essentially a monitoring scheme, NILS surely has an excellent potential for future research. The mere spatial scale on which NILS operates, with its grid with more than 600 5X5km plots across the whole Swedish land base, and its high number of variables monitored should provide an excellent potential (resulting in a score of “5”). However the strategy actually lacks precision and there is no real strategic plan (yet). Permanent vigilance for data quality (e.g. with an independent evaluation through a user and scientific committee could be an excellent evaluation instrument) is essential as well as further national and international cooperation. In order to stabilize funding, active participation and/or development of research projects seem essential. This will also increase the recognition, impact and trust in the data collected and managed by NILS.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

See B2

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

As put forward, an active search for further national, international collaboration is important. Probably the best way would be the development of common research and/or monitoring projects, making it more internationally important for the e.g. the EU. See also B2.

B 5. Additional information

Nils is important not only for its own sake and that of the stakeholders. It has the potential to become an important platform for research for departments such as Forest ecology and management, Wildlife, Fish and Environmental studies, Forest resource management, Ecology, within SLU and outside it. Benefits to research within this unit should also be considered a merit of NILS.

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 295_4 Forest History and Forest Vegetation Ecology

B 1. General assessment of the Unit of Assessment

The research is focused on the conservation and ecology of temperate broadleaved forest flora and fauna in southern Sweden. There are 6 members of the UoA, making it a small unit specifically located in Alnarp in order to study the temperate species. It is uniquely positioned within the Southern Swedish Research Centre. There have been three interdisciplinary research programmes over the years, 1) Sustainable Management in Hardwood Forests focused on the 8 valuable temperate broadleaved tree species native to the region with funding of 50MSEK provided by the forestry faculty at SLU and external funders, 2) Spruce research programme concentrating on the management of Norway spruce stands in southern Sweden with funding of 25MSEK provided by the forestry faculty at SLU and external funders and 3) Sustainable Forestry in Southern Sweden (SUFOR) which covered aspects of biological research with funding of 105MSEK provided by SLU, Lund University and Lund technical university. External funding is received from research councils, research foundations as well as public authorities. The programme sees itself at the intersection of the fields of conservation and historical ecology with emphasis on the conservation of temperate broadleaved forest flora and fauna. The publication output is good as is the gender profile.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The presentation contained an overview of plant species distribution in Sweden and the associated need to have the specific geographical location in southern Sweden to study the temperate broadleaved forest fauna and flora. There are a large number of red-listed cryptogram species on the tree trunks, the forest floor and the stumps. The benefits to the Unit of being close to the field sites and to the forest managers were clear. Documentation provided evidence of the development and use of pollen analysis and dendrochronology as tools for understanding past change. Much more time has been spent on refining the methodology and data management of the project than on the scientific aspects. The intersections of the fields of conservation and historical ecology have not been developed. The links with silviculturists was deemed to be useful but there was little evidence to support why this association was of value and how it was being used to enhance the quality of the research. There were no ideas on how to value the biodiversity. The focus on fire seems to be overemphasized, considering the low return frequency and impacts of fire. There was also little context for the historical aspects of the study, there were no social components to the study in trying to understand changes in the landscape over the last 200-300 years. There should have been collaboration with the Dept of Agriculture in order to assess the degree of grazing in these systems and how that could have altered the history and utilization of the

system over the years. The number and quality of publications were good but there is a lack of overall profile of the unit.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The group suffers from being too small, having poor staff retention and having many of the staff being counted in other Units. There are also very few senior staff. The group has been recognized in the past but it appears to have lost momentum and to have no main focus of research. There is no overall conceptual framework for integrating the research ideas. The project could be strengthened by broadening the tools for understanding the social and biological patterns of change in land use and land use management over the last 300 years and the associated impacts on conservation and species vulnerability. The Unit is recognized by the local forestry sector. The Unit has received recognition in 2007 and 2008 by receiving significant increases in funds, the publication output also increased significantly in these years.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

This group collaborates strongly with a number of stakeholders including the National Inventory group which holds training workshops for about 20 staff annually which have been ongoing for 3 years. Training of students that move into industry is a great strength of the Unit in that it exports knowledge into the forestry sector. Six PhDs or licentiates have graduated from the Department and are active in the forestry sector. In addition, a member of one of the forestry boards has registered for a PhD with the Unit. There is close contact with 3 county boards Halland, Skåne and Blekinge. This Unit has developed a number of fact sheets and reports over the years. There are substantial interactions with stakeholders.

The geographical location of this Unit appears to be the sole reason for its existence. The panel believes that this rationale should be reviewed strategically.

On the basis of this evaluation, award a score from 1-6 ³:

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

There was extremely limited information provided on the current strategy or the vision for the future. Emphasis was placed on human capacity building and retention and wanting to produce one PhD dissertation per year. The Unit acknowledges that they have not reached potential and believe it is a function of their small size and they believe that they require a full time funded professor. The integration of conservation issues into forest history has not been well defined. The new climate change, bird biodiversity and distribution project is very narrow and will not help to build the overall scope of the programme.

On the basis of this evaluation, award a score from 1-6 ⁴:

2

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The Unit is strong in its interaction with FOMA activities particularly the NILS programme

B 4. Actions for development at the Unit of Assessment

The panel recommends that this group should be placed within a much stronger Unit e.g. Forest Vegetation Ecology, and be allowed to carry out its activities in southern Sweden. It is only a Unit because of geographical position. The projects could be developed in an integrated programme addressing land use history, land use management and conservation. There are a number of tools available that could be applied to look at trade offs and economic analyses of conservation and land use. The engagement of the agricultural community in changes in the landscape over the last 300 years would be most beneficial. There is little comparative advantage for the Unit developing a climate change agenda.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 415_2 Landscape and Soil Ecology

B 1. General assessment of the Unit of Assessment

The research is focused on the links between soil ecological processes, community ecology and landscape ecology. The emphasis is on population dynamics and interactions at a local and regional scale. The publication output is good as is the gender profile. The Unit has a great potential but the integrated strategy for achieving its potential needs to be improved.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The presentation provided the panel with an overview of the work that was conducted as well as some specific examples of biodiversity, metapopulation and nutrient cycling studies on tree stumps. The conceptual framework showed the linkages between ecological processes and the landscape but with a very strong emphasis on the role of the species. Even though the UoA is called “Landscape and Soil Ecology” there are very few conceptual elements of the disciplinary field of Landscape Ecology, which is usually much more focused on movement and transfer of elements between position in the landscape and trophic levels. The Panel believes that the UoA focuses on Populations in the landscape. The strengths lie in the research conducted on soil processes within an agricultural landscape. There were a number of examples where theoretical aspects have been applied successfully under field conditions. Data presented on biodiversity and ecosystem services in agricultural landscapes was most impressive. The science is solid and of high quality. The publications appear in a wide range of very high impact journals.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA is highly regarded and the senior professor has a well established international reputation. He serves on a number of science steering and funding committees. Other members of the Unit are also well recognized. There is a large staff who are well managed.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

The research is recognized in that the sections on biodiversity are well funded. There has been a very high throughput of PhD students.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

There have been extensive interactions with stakeholders. The research conducted by this UoA on organic farming, is highly valued by the Swedish Board of Agriculture, having a major impact on the subsidies to farmers associated with these practices. There have also been interactions with the Energy sector on the removal of stumps. Fact sheets and reports have been produced over the years. There are many national and international collaborations which have been strategically chosen by the UoA.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The documentation reflects more on what was achieved in the past than an integrated strategy for the future. There was plenty of evidence in the presentation that this group is able to achieve high quality science and that they have chosen to focus in the area of biodiversity, biological processes and climate change. The Panel recognizes that the Unit is new and that much energy has gone into redesigning the Unit into a cohesive group with great potential. The Panel acknowledges the way the Unit has defined 5 goals with associated strategies. The potential of the Unit will be realized through the development of a more integrated strategic plan. The Panel recommends that the Unit should think about their title so as to be able to convey more clearly their research strengths.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The panel would recommend that there would be benefits in merging this UoA with other UoA's currently within the Department of Ecology, e.g., Conservation Biology. Some form of reorganization around conceptual content seems necessary to strengthen individual units and to reduce overlap and redundancy.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 415_5 Conservation Biology

B 1. General assessment of the Unit of Assessment

Research at the UoA is directed towards conservation biology, i.e., scientific knowledge that can help solve problems related to nature conservation, and especially the maintenance of biodiversity. The direction is broad and includes subject areas like dead wood ecology, epiphyte metapopulation dynamics, systematic conservation planning, lichen ecology/taxonomy, insect ecology and environmental monitoring. Examples of conservation issues that are studied are effects of forest-fuel harvest on biodiversity, efficiency of matrix management in boreal and tropical forests, cost-efficient reserve selection, and epiphyte dynamics in oak-dominated landscapes. Main emphasis is on forest landscapes but urban and agricultural environments are also studied in a less proportion. Study organisms include birds, butterflies, beetles, lichens, bryophytes, fungi and vascular plants. Research projects emanate from topical questions in today's land-use identified through end-user interaction but there are also more basic approaches, e.g. regarding species' ecology and taxonomy.

Altogether, the UoA addresses very different topics that are not yet integrated in a coherent way. Moreover, there are sometime overlaps with topics addressed by other UoA in the same Department (Ecology: Landscape and Soil Ecology, Population Biology), or in other Department (Southern Swedish Forest Research Centre: Forest History and Forest Vegetation Ecology). Conservation Biology is a relatively young unit, however (1.5 yr), and the discussion with the panel has shown that research will be organized along two main directions in the future: ecosystem services and climate change. This seems certainly an excellent strategic initiative, even if the risk of overlap with other UoA still remains, mainly on the climate change issues.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Scientific quality was rated as 4 for the following reasons: (1) there is no integrated research strategy; rather each researcher has her/his own research question(s) and method(s), without the level of integration required for the constitution of a strong research group; (2) research seems mainly driven by a top-down, opportunistic strategy of answering needs of stakeholders rather than a bottom-up strategy of proposing sound research questions to funding agency (possibly including stakeholders).

Scientific productivity is rather weak, with 123 publications on a 5-yr period for 13 researchers (excl. PhD students), i.e. ~ 2 papers/researcher/yr. Bibliometric data show an encouraging increase in productivity during the past 2 yr, corresponding with the initiation of the Conservation Unit.

The 5 bibliometric indicators provide a convergent picture of values higher than average,

which indicates that researches of the UoA are having a substantive impact in the scientific community. The lower value of the Normalized Journal Citation Score indicates that the publications are published in journals with relatively low impact factors in the field. International collaboration exists but here again on an individual basis.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The recognition and leadership capacity of the UoA was given a 5. The leading position of the unit in its field is still questionable given (1) its recent formation and (2) the lack of clear research questions mentioned above. The attractive research environment is very good, as demonstrated by (1) the visit of scientists from within and outside Sweden for research cooperation and seminars and (2) the recruitment of post-docs and junior researcher from Sweden and abroad within the unit.

Regarding the more internal functioning, the unit is still in an establishment phase. Regular unit meetings and literature seminars are so far their main activities.

As stressed before, much of the research of the unit is oriented to end user needs. The unit seems to be highly respected and appreciated by stakeholders, as shown by the external funding ratio in its funding profile, even if the total volume is still moderate. The excellent reputation of several members of the UoA in the stakeholder community, and their uncontestable reputation justify the high score of 5.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Relevance is very high. Conservation biology is of the utmost importance for society in an era of uncontrolled and rapid environmental change. The two main directions that are proposed for the future organisation of the research unit (ecological services and impact of climate changes) are highly relevant to sustainable development of society, including industry.

These two questions (ecosystem services and climate changes) have both a global and long-term perspective dimension.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The UoA potential resources for renewal seems good given the recent recruitment of two junior researchers and three postdocs together with the recent recruitment of four PhD students

Concerning the gender balance: the head of the unit was the only female head met by the panel, even if the proportion of women is only 15% among professors, researchers and junior scientists, whereas it is of 60% among PhD-students and post-docs. This suggests that there might be a gradual change in gender balance through time. Moreover, the gender issue is explicitly considered during recruitment.

The strategy of the unit in its self-assessment document is extremely detailed: a rather long list of precise milestones provide excellent landmarks for the future.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

1. Research of this UoA is now clearly pattern-oriented. However, there is a clear trend to go into more conceptual issues, which will strengthen the international visibility of the UoA and promote a positive development. Discussions with the panel have shown that researchers are aware of the importance of this reorientation.

2. The reorganisation of the research along the two axes proposed by the researchers (ecological services and impact of climate change) will clearly strengthen both the research and the relevance of the research of the UoA. Overlaps with the research agenda of other units are a danger that could be avoided by the implementation of transversal research programs within the Ecology Department, for instance on the effects of climate change on biodiversity.

3. Research collaborations certainly need to be developed on a unit base. The invitation of scientists from Sweden and abroad is certainly a first step in the good direction.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 415_6 Population Ecology

B 1. General assessment of the Unit of Assessment

Like other units we reviewed, this is a relatively new unit split off from the former Conservation Biology group. We were informed that the size of the unit had increased recently to 12 people, including a new junior researcher (4-year position), a new PhD position and four postdoctoral positions. This is a significant increase given the small size of the unit and reflects on the impressive activity they are undertaking. The research profile of the unit is strong and focused; it was impressive. There is need for the addition of expertise in population dynamics modelling to increase research depth and profile. Similar comments about the need for expertise in population dynamics modelling also were expressed by other UoA's. Clearly this is an area that would benefit the Ecology Department as a whole, and the Population Ecology unit might be the appropriate place for such expertise to be housed. There was some concern expressed by the panel that the size of the unit may be too small, both in terms of having enough depth for interaction and expertise to draw on. Also, the unit's small size means that it is vulnerable to the loss of one or more members for any period of time. This was a pattern evident across several UoA's in the Ecology Department, and it may be appropriate for the department to consider forming units of larger size.

The unit had developed a number of collaborations within the Ecology Department and beyond. Most of the collaborations were within the discipline of ecology (i.e. only limited interdisciplinary collaboration was evident), however, this seemed appropriate given the focus of the unit.

The research of the group is well grounded in the theories of population ecology, and from this platform is able to provide important and invaluable insights for applied research and management of Swedish resources. They used a number of model organisms to test their theoretical approaches, and collaborated with other groups in terms of applied application (e.g. wolf management, farmland management for Swedish birds).

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - Research

1. Scientific Quality

The panel appreciated that the unit was undertaking research of a high international standard with regards to both theoretical and applied aspects. The research is being published in leading general scientific journals (e.g. *PLoS One*), as well as leading journals within the field of ecology (e.g. *J Animal Ecology*, *American Naturalist*, *Ecology*, *J Applied Ecology*). The UoA identified a clear theoretical foundation to their research into understanding the drivers of population dynamics and source-sink relations. They were critical of existing theory and recognized the importance of testing it. The pattern-based work involved novel ideas applied to systems, such as that of bird communities at local and landscape scales. This was combined with process-based research using a series of model systems with impressive long-term data

sets that involve organisms from Pacific oysters to birds and wolves. The combining of these two approaches provides valuable insight into conservation strategies for the Swedish landscape. The UoA's approach of going beyond simply collecting data to a more thematic approach involving the testing of specific hypothesis was recognized as an important strength. There was clear evidence of originality of ideas and appropriate choice of methods. The geographical scope of the work is broad and incorporates a number of academic networks and collaborations, particularly at the Nordic scale. In addition, there is European scope to some of the work through participation in AGRIPOPEs. The UoA should continue to be encouraged to emphasize the high quality of their research, even at the expense of producing large numbers of publications.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The panel felt the UoA showed excellent recognition and leadership. They are an internationally recognized unit and have good collaboration at the national and international level. Their involvement in PhD and postdoctoral training is impressive. While the unit is small, it was clear that the collaborations that it had fostered were instrumental to the attractive research environment that it offered

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The ability to incorporate information about individual behaviour, source-sink dynamics and ecological traps to understand population processes is central to informing conservation biology. It was clear to the panel that this was a strength of the UoA. However, both the panel and the UoA recognized that communication of the value of such information to stakeholders needed to be improved. Given the small size of the UoA, the researchers face a difficult dilemma in finding time to better communicate their results to stakeholders while undertaking an intensive research programme. It was suggested that some form of extension assistance from SLU would be advantageous not only in communicating findings, but also in terms of influencing follow-up with regards to resulting management actions.

There is a strong national and Nordic relevance to the research (e.g. Nordic farmland bird communities, wolf populations). The work on northern wheatears is unique internationally and provides important insights into the theoretical underpinnings of population processes. Given the invaluable long-term data sets that the unit has accumulated, the temporal dimensions of their research are impressive.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

Among the UoA's assessed by this panel, the Population Ecology Unit presented one of the few research strategies with a clear theoretical foundation to the empirical research they were undertaking and proposed to undertake. A focused research direction for the unit was expressed that was ambitious, yet appeared to be achievable. Recruitment of PhDs and post-doctoral fellows was good. One concern identified by the panel was the small size of the unit, which threatens its resilience should one or more of its senior members be absent for a period of time. A need was expressed for increased competence in population modelling, something that was also expressed by several other units.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA has no FOMA operations at this time.

B 4. Actions for development at the Unit of Assessment

- Recruitment of someone with greater population modelling competence than currently exists within the unit. An alternative approach to addressing this issue would be to develop collaboration with individuals outside SLU having such competence (e.g. Norwegian University of Science & Technology – Steinar Engen).

B 5. Additional information

- The size of the UoA was particularly small, bringing into question its resilience/sustainability. The Department of Ecology might consider creating units of somewhat larger size by merging units having similar interests. This would also reduce communication barriers that might arise from have many units of small size.
- SLU might consider providing some form of increased support (personnel) to facilitate communication with stakeholders. The researchers showed a keen interest in improving the communication of their results, but had limited time to do so.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Science

Unit of Assessment: 415_8 Systems Ecology

B 1. General assessment of the Unit of Assessment

This is a small and powerful unit with productive scholars conducting cutting-edge science on nutrient cycling and dynamics, primarily C:N:P in forested ecosystems. The quality of science and the unit's vision are truly outstanding. The research has been focused and rigorous, with results that have global implications. The unit has strength in mathematical theory and nutrient-flux monitoring, contributing directly to the spirit of the Foma program. The unit has an excessively narrow focus relative to systems ecology, which they define only to describe "ecosystems in terms of states and fluxes of elements." Nevertheless, this focus resonates with society's current concerns about carbon emissions and global climate change.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Scientific quality in the Systems Ecology unit has been outstanding resulting in publications in the world's leading scientific periodicals including *Nature*, *Ecology*, *Ecology Letters*, *Annual Review of Ecology, Evolution and Systematics*, and *Global Change Biology*. Two of the unit's leading scientists have backgrounds in physics from which they have drawn on their skills with mathematical modeling to contribute to the development of theory on nutrient flux. Although clearly basic science, this use of mathematics has been used strategically on ecological problems that must be rated as the ultimate highest priority. Indeed, one might argue that this research program is amongst the most important science being done anywhere in the world because it has direct applications to global climate change that threatens global ecosystems.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The scientists in this unit are well respected internationally for their excellent research, and are leaders in their field. They are well known and widely recognized in the field, and they serve on the editorial boards of leading periodicals. We are concerned about the long-term

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

viability of the unit because so much of its current research power is attached to the leader, Göran Ågren, who is nearing retirement. More attention to pedagogy at this crucial time could be helpful, recruiting young people to the unit who would continue its mission. In the unit's self assessment they complain about the inability of their colleagues and students to achieve their level of mathematical rigour:

“We have not been successful enough in making all our research wide-spread enough. A part of this results from our use of mathematical techniques which are beyond the level of a large part of the relevant scientific community.”

Yet, we believe that this could be turned around to identify a failure of the unit to train the next generation of scientists who can continue the strong theoretical tradition in this program. And further this quote points to the failure of the unit to communicate effectively with the larger scientific community, let alone the stakeholders who need to know about the research.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

There can be no question of the utmost importance of the research being conducted in this unit. Carbon flux associated with industry may be fundamental to its long-term sustainability. Therefore, the research of this unit is directly relevant to an evaluation of the sustainability of development. On a global scale we submit that this unit has earned an outstanding reputation for relevance and impact. A weakness of this unit relates to its inability or unwillingness to communicate effectively with stakeholders. This can be resolved relatively easily by working with the faculty's information officer and developing an effective website. We believe that the relevance and impact of this unit can be increased by more effective communication, especially within Sweden.

Global influence with long-term implications.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

As noted above, we are concerned about the future of the unit given its small size and the consequences of the eventual retirement of the unit leader. This is an important consideration regarding the potential of the unit, because Professor Ågren is the primary source of the theoretical research. We believe that Dr. Achim Grelle will sustain a strong empirical program in nutrient flux monitoring which supports the FOMA function of the unit, but it should be a priority to ensure continuity in their theoretical research program as well. The program would benefit from being part of a larger unit, and this would be easy to achieve given that several other units within the SLU system focus on climate change studies and

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

nutrient dynamics. The Systems Ecology unit needs to become much more effective at marketing its research. The unit recognizes this weakness and must allocate some time and resources to making it happen.

This unit suffers from small size and narrow specialization as we saw in several UoA's in the Department of Ecology. One possible strategy would be to develop cross-unit research programs on broad themes, e.g., global warming. Several units have research programs on global warming but we did not see evidence of interaction among these UoA's.

On the basis of this evaluation, award a score from 1-6⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

FOMA is an integral part of this unit, and the fit is excellent. Nutrient flux monitoring is precisely the sort of empirical data needed to evaluate the theoretical research, so this environmental monitoring program could not be better placed. The FOMA operations of this UoA enjoy outstanding quality, excellent recognition and leadership, outstanding relevance and impact, and excellent strategy and potential.

B 4. Actions for development at the Unit of Assessment

- The investigators in this unit could do a better job of championing their work to a wider audience. Although the research is being published in top-ranked scientific periodicals, they fail to promote their research to the public and stakeholders. There might be an opportunity for SLU to assist with news releases and popularization of the work.
- Merging this unit of assessment with other groups would be beneficial. Widespread weakness in mathematical modelling throughout the SLU system could be enhanced by joining the theoretical expertise in this unit with other units. Furthermore, several other units reviewed by this panel conduct research on ecological consequences of climate change and direct interactions with the members of this unit would be beneficial.

B 5. Additional information

In many if not most of the units we reviewed in the Ecology and Environmental Sciences panel, we heard of weakness in modelling and quantitative science. Clearly the SLU needs to bolster its competency in ecological modelling. This is not a weakness in this unit, but unfortunately this unit does not share its expertise.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3 Ecology and Environmental Sciences

Unit of Assessment: 415_9 Wildlife Ecology

B 1. General assessment of the Unit of Assessment

The Wildlife Ecology UoA undertakes applied research aiming to a) assess individual and demographic parameters and habitat use, b) identify how individual and cohort parameters such as, e.g., density, habitat selection or predator avoidance translate into temporal and spatial population dynamics, and c) use this knowledge to derive recommendations on the harvesting and management of viable wildlife populations. Focus of the Unit is on large mammals, both carnivorous and herbivorous ones, and there exists a societal need for scientifically based management strategies for these species. Methodologically, the aims of the Unit are approached mainly through long-term monitoring studies on the one hand (including the measurement of individual traits, spatial and temporal patterns in habitat use, intra- and inter-species interactions, etc.) and population modelling on the other hand, with model predictions being validated against field data. The Wildlife Ecology Unit is located at Grimsö Wildlife Research Station and currently consists of 13 researchers and 6 PhD students. The Unit is intimately connected with the Wildlife Damage Centre (also located at Grimsö) and it actively collaborates with other, partly more theoretically driven Units such as Population Ecology.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific strength of the Wildlife Ecology Unit, for which the group is internationally well recognized, relates to long-term ecological monitoring studies, which enable the Unit to identify the consequences of individual- and cohort-level differences on population dynamics. While this approach is mainly correlative, the group has initiated more mechanism-oriented work, and this development will enhance the scientific quality of the Unit. The research of the Unit is restricted to questions related to wildlife in Sweden and the Nordic Countries, but the findings are relevant beyond that geographical area. An excellent example of this Unit's research work is the establishment of the pedigree of the Scandinavian wolf population.

In the period from 2003 to 2008, the Unit has roughly doubled its publication output compared to the 1998-2002 period. Most bibliometric indicators perform at average, but the field normalized citation score is significantly above average, pointing to a good perception of the publications of the Wildlife Ecology Unit by the scientific community. One factor most likely contributing to the good perception of the scientific output of the Wildlife Ecology Unit are long-term population ecological studies. The progress the Unit has made during recent

years in the field of population modelling is probably too recent to be yet reflected in the bibliometric indices.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has leadership in applied research on wildlife populations. The results from the research of this group strongly influenced scientific debates on the management of wildlife populations in Sweden, but also in other countries across Europe. An indication of the leadership of the Unit comes also from the fact that 3 out of the 12 PhD students awarded in the period 1998 – 2008 succeeded in finding positions at higher education institutes abroad. At the national level in Sweden, the Unit is closely incorporated in a dense network of collaborations with other research groups, both within and outside SLU.

With respect to the Unit's role in society, the long-term experience of the Unit in wildlife ecological research, and its close interactions with both stakeholders and interest groups (e.g., hunters) appear to give credibility to the Unit as a source of opinion, as it also evidenced from the frequent involvement of the Unit in policy- and decision-making processes. There is no doubt that the group is highly visible in society in general and among relevant stakeholders in particular.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The needs-driven research of the Wildlife Ecology Unit has successfully generated societal relevant information over the last 10 years and without doubt the Unit has the potential to continue this way. Importantly, the Unit does not only generate scientific knowledge, but it also succeeds in transferring this knowledge to the society. To this end, the Unit employs targeted information to stakeholders and decision makers. For channeling information to stakeholders, the close interaction of the Wildlife Ecology Unit with the EPA-based Wildlife Damage Centre appears to be of particular value.

The research of the Wildlife Ecology Unit is of very high if not utmost importance for the regional and national scale in Sweden in particular and in the Nordic Countries in general. In addition, the research of the Unit on wildlife management extends beyond the Nordic region and has European relevance.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

The Wildlife Ecology Unit has recently taken strategic decisions that proved to be successful in strengthening its scientific quality. These decisions, i.e., the hiring of a researcher with expertise in population modelling as well as the envisaged move of a molecular biology-experienced researcher to the Grimsö Station, involve recruitment of younger faculty. Another example of successful extension of the research competence of the Unit is the adoption of GIS based surveillance of wildlife. These strategic decisions highlight the renewal potential of the group and its ability to enhance its scientific quality.

The Unit has identified actions and plans to further develop its research capabilities, to attract Swedish and foreign graduate students and early-stage researchers, and to maintain its societal impact. These actions are appropriate to extend and refine existing research approaches for a medium-term time scale. What is less clear are the longer-term strategic aims of the Unit.

The Unit utilizes synergies with various UoAs at SLU but there appears to be potential for further enhancement, in particular collaboration on theoretical and conceptual aspects would support the ongoing effort of the UoAs to go beyond the previously prevailing focus on empirical, single species-oriented questions.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The Unit is currently not involved in FOMA directly, but several of their research projects could be cast in context of monitoring.

B 4. Actions for development at the Unit of Assessment

The Wildlife Ecology Unit is very good on applied ecological research (as well as in transferring knowledge to society), but it should try to strengthen its concept/theory-driven work. As mentioned above, first steps in this direction have been undertaken already – with good success – but it is important to intensify this development. The applied, needs-driven approach of the Unit would benefit from an enhanced integration with more theory-driven groups in the Department of Ecology. We are aware that there collaborations already exist, for instance, with the Population Ecology UoA, however, such collaborations need to be extended, both in terms of intensity and in terms of interactions with more groups.

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⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

One question that needs to be considered in this context is how stronger integration among Units of the Ecology Department (and perhaps even outside) could lead to capacity building in currently under-represented areas of expertise. For instance, modelling expertise is needed by several groups and could be particularly valuable to develop a more hypothesis-driven ecological research within the department. The current response to this need that each group develops local solutions, but stronger integration of such activities as well as support at the Development level may lead to over-proportional benefit for all units.

The research of the Wildlife Ecology Unit is almost exclusively focused on Sweden and the Nordic Countries. While the reason for this is evident, stronger international collaboration – as currently the case for the roe deer project - might be helpful in further promoting the scientific quality of the Unit. Many problems addressed in wildlife research and questions formulated with respect to wildlife management exist in more or less similar ways in other countries. Consequently, the EU repeatedly publishes calls on topics related to wildlife and wildlife management, and the Wildlife Ecology Unit might benefit from participation in such programs. Particularly in the context of the climate change research, the need for international interaction in the wildlife field will increase. Up to now the Unit has under-exploited such opportunities for strengthening its research, and the group is encouraged to take more advantage of increased international collaborations.

We encourage stronger coordination with Wildlife, Fish & Environmental Sciences in Umeå to minimize overlap and to create synergies. The strong research on multi-species predator-prey interactions in the Wildlife Ecology UoA has potential for important theoretical advance. And this can contribute to the ongoing adaptive management programs that they share with the Umeå group. Perhaps these units might consider annual retreats to coordinate efforts and to clarify their respective mission statements.

B 5. Additional information

We see this program to be complementary to the research conducted in the Wildlife, Fish and Environmental Science program in Umeå. A stronger mission statement by the Grimsö unit with a focus on multi-species predator-prey interactions seems appropriate.

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 713_1 Ecotoxicology

B 1. General assessment of the Unit of Assessment

The Ecotoxicology Unit links environmental issues, i.e. chemical and microbial contamination of the environment, to veterinary issues, i.e. animal health and food safety. With this innovative approach, the UoA is at the crossroads of several disciplines, as is also reflected by the fact that this was the only Unit of the Veterinary Medicine and Animal Sciences Faculty that was reviewed by the Ecology and Environmental Sciences Panel. Further, the Unit takes a pioneering role in the Veterinary Medicine and Animal Sciences Faculty: Environmental health is an established key issue in research on humans (see, for instance, recent concepts of the US NIEHS), and it is becoming increasingly important for the concepts of animal health, population medicine, animal welfare, and food safety (fork-to-food chain). The UoA is involved in FOMA activities which perfectly complement and extend the Unit's research activities.

The UoA has currently a research staff of 1 professor, 3 junior staff and 2 PhD students, but no senior staff.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research ideas of the UoA are original and innovative (see above). To achieve the ambitious scientific goals, the Unit uses a broad array of state-of-the art methods, from pathology to chemical analyses and molecular techniques. The Unit relies on both laboratory studies using vertebrate model species and on field studies addressing important environmental problems in the Nordic Countries and the Baltic Sea area. These case studies, although taking place at the regional scale, have global relevance and are well perceived in the scientific community.

The research of the Unit has high international recognition but has suffered from decreasing scientific productivity over the last few years. Factors contributing to this trend may include the small size of the Unit (together with the fact that the Unit leader has to use some of his time for his function as Department head), as well as current emphasis on transferring the scientific knowledge acquired over the last years into practical tools for regulatory risk assessment – an activity that is of high societal relevance but not associated with scientific publications. As the Unit is small and, even more important, has only one senior staff (the Unit head), such situations cannot be compensated for. The UoA effectively engages an

intensive academic network of both national and international collaborators to overcome certain limitations of the limited staff resources and to generate internationally competitive research.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has high international leadership in the scientific debate on the impact of environmental stressors on animal health. For instance, during the recent decade, when public and scientific concerns were rising on the potential adverse impacts of hormonally active compounds on biota including man, the UoA succeeded in taking a highly prominent role and was representing Swedish research in numerous international research projects, committees and expert panels. The prominence of the UoA in environmental and animal health research is further evident from the extremely well developed collaborative network, both within Sweden and internationally. In fact, the national and international connection of the UoA is of outstanding quality. Further, the UoA has excellent international recognition for its contributions to the development of tools and approaches for environmental risk assessment

Within Sweden, the UoA has outstanding recognition for its expertise in questions of environmental pollution and health problems of wildlife species. This is reflected in the intensive involvement of the UoA in research on and monitoring of animal health problems in aquatic environments of Sweden and the Baltic Sea area, and it is evident from the activity of UoA members as Swedish representatives in expert committees of international bodies such as OECD and being a focal point for Swedish EPA. The engagement of the UoA in such activities is relevant for society as well as industry.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research of the Ecotoxicology Unit is of utmost importance for a) detecting, monitoring, and evaluating environmentally (man-made pollution by toxicants and pathogens) induced diseases in (aquatic) wildlife species in the Nordic Countries and the Baltic Sea area, and b) for developing validated tools for chemical risk assessment. These activities are of scientific relevance, but they are also of highest relevance for the society and industry in that they enable the diagnosis of adverse changes in the environment and the prediction of potential risks arising from the use of chemicals. One practical example where this UoA makes a major contribution is the development of tools for the European REACH system.

Another strong aspect of the UoA research contributing to sustainable societal development is the strong engagement in environmental health research in developing countries.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

Although the work of the UoA is partly performed at a regional scale (Sweden, Baltic Sea), the problems addressed by the research are of international relevance, since similar problems in aquatic and semi-aquatic biota occur world-wide.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA has a clear strategy where to move next in its research. The aim to promote the environmental health issue in veterinary sciences because this represents an original and novel approach. Therefore, the panel sees high scientific potential for the UoA. However, at the same time the panel sees the risk that the strategic research aims might not be realizable because of the small size of the UoA. The risk comes not only from the low number of personnel, but also from the not well balanced composition, i.e. 1 professor balanced by only 3 junior staff, but no other senior staff. This makes the Unit vulnerable (and is probably one of the reasons behind the limited scientific productivity – see above) and raises questions on the sustainability of this field within the Veterinary Sciences and Animal Health Faculty (see also recommendations below).

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The FOMA activities of the Unit perfectly complement the research activities. As information on persistent pollutants in brown bears and on environmental contamination by veterinary pharmaceuticals is very limited to date, the FOMA activities go clearly beyond pure monitoring work but have a strong and promising research component.

B 4. Actions for development at the Unit of Assessment

With respect to societal impact, research planning and strategy, the UoA is well on its way and has very high potential. As outlined above, risk to the further development of the Unit comes mainly from its small size. Because the research performed by this Unit is innovative and unique and complements the profile and international visibility of SLU, the panel advises SLU to provide more support to the Unit.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 3. Ecology and Environmental Sciences

Unit of Assessment: 910_4 The Swedish Biodiversity Centre

B 1. General assessment of the Unit of Assessment

The UoA has an extremely important role in supporting research on biodiversity at SLU and at other universities. The Swedish Biodiversity Centre was created to fulfill the commitment of Sweden to the Convention on Biological Diversity. It has a self-declared mission of piloting, initiating and coordinating research on the preservation, sustainable use and restoration of biodiversity in Sweden. The Centre has both a multi- and interdisciplinary nature, by documenting the effects of multiple human activities on the three levels of biodiversity (genes, species and ecosystems), at various spatial scales and temporal scales (including history). The Ecology and Environmental Sciences Panel considers that a fusion between the National Inventory of Landscapes in Sweden (NILS – UoA 910_4) and the Swedish Biodiversity Centre would have an extremely high added value, by combining a unit specialized in environmental monitoring to a unit specialized in biodiversity research planning. According to the stakeholders of the Ecology and Environmental Sciences Panel Threatened Species Unit (that we did not review) could also join this consortium.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The Ecology and Environmental Sciences Panel has considered that the scientific quality of this UoA was not assessable. This UoA is clearly not a research unit but rather a unit providing strong support to research.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has shows excellent leadership in biodiversity research within Sweden, by (1) identifying research questions with a strong societal impact, (2) organizing the funding of the operation, (3) directing and coordinating the research efforts of the scientific communities and (4) reporting the final results to the society. This four step demarche is effectively realized by

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

the UoA as demonstrated by the successful achievement of several projects since its creation (e.g., HagmarksMistra, Research to forge the conservation chain or Include). Moreover, the Swedish Biodiversity Centre plays an important role in the scientific debate at the EU level, as demonstrated by the pioneering role of the bioheritage program (biological heritage in European landscapes).

The role of the UoA as an independent and trusted source of opinion is indicated, for instance, by its choice as focal points for the Ministry of Agriculture and the Ministry of the Environment.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA's present and future contribution to sustainable development of society is extremely important. The sustainable development of the society is at the heart of its activities. Central to its preoccupation are the 16 objectives listed in the CBD. The Swedish Biodiversity Centre currently addresses 10 out of these 16 objectives in an outstanding manner. Its involvement in development projects funded by SIDA, which aims at fostering biodiversity as a resource for poverty alleviation, is a good example of this commitment.

The research focus of the Swedish Biodiversity Centre covers the whole range of dimensions, from the local to the global spatial scale and from short- to long-term perspectives, including an historical aspect (ethnobiology).

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA has performed a deep internal reorganization by developing a structure around 7 different subject fields (agricultural and alpine areas, forests and freshwaters, community planning, cultivated diversity, global genes, traditional knowledge and development and cooperation). The subject field leaders are members of a group that discusses ongoing programs, potential future programs, links between programs etc., at regular meetings. This structure benefits from administrative support allowing smooth daily functioning. This is indubitably an excellent strategy.

In their strategic plan, the members of the UoA ask for academic support from the university, which should increase both their efficiency and their visibility. The Ecology and Environmental Sciences Panel considers that this demand has a fair basis. However, we recommend that this support comes from the creation of a user committee including several academics from all the universities that benefit from the expertise of the Swedish Biodiversity Centre. This could provide the Centre with complementary competences in a wide variety of

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³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

scientific expertise, and certainly reinforce its visibility.

In their strategy for the future, the members of the UoA also asked for the possibility of having a research status. This should allow them to keep the indispensable scientific skills required to efficiently pilot and coordinate research programs. We think that 30% of their time could be allocated to research.

The Swedish Biodiversity Centre has a great potential for the diffusion of results from the scientific community in ecology and environmental sciences to the stakeholders and the society at large. This potential should be exploited by SLU: we noticed that the efforts devoted to the “third task” were often not sufficient in many of the units we reviewed in the Ecology and Environmental Sciences panel, by lack of time, competence and/or interest.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

B 5. Additional information

The Ecology and Environmental Sciences Panel is concerned by the current status of the Swedish Biodiversity Centre. It was clear to all of us that a strategic decision should be taken quickly by SLU on the future of this exceptional research support unit: either it should be considered as a part of SLU, which means that the University will support its current status and its future development by guaranteeing its institutional and financial sustainability, or it should be attached to the Swedish EPA.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 4. Food Science and Safety

Profiles

The research field of Food Science and Safety consists of three units; Food Science (FS), Toxicological Food Safety (TFS) and Microbiological Food Safety (MFS). The first UoA (FS) has 24 scientific persons on the faculty and 20 PhD students. The mission of FS is to provide reliable information on food and its different qualities through the whole food chain. The UoA collaborates with a number of departments and organisations within and outside of SLU. TFS and MFS are small units, which are organised within the Department of Biomedical Sciences and Veterinary Public Health. The mission of TFS is to deliver hazard and mechanistic information on chemicals from the food chain and to work on risk assessment in food toxicology. MFS has recently been reconstructed to focus on food safety. Research areas are microbiological food safety and risk assessment concerning microbial hazards. Both TFS and MFS collaborates with the Veterinary Public Health and other agencies, both national and internationally.

Scientific productivity, performance and quality

While the average citations per paper are on the same level for all 3 units (ca. 10), most other indicators give the highest scores for FS. The bibliometric profile shows that FS scores above average SLU performance for all indicators. MFS shows high importance, while only on par with the average SLU performance on 4 of the indicators, but with a high scaled Hf-index. TFS scores lower than the average SLU performance for most indicators. In overall, it is reasonable to assume that FS has the higher average quality and impact of the 3 units.

Strengths

Broad expertise from raw material production to food; biomarkers and plant product research; in vitro models for toxicological research and risk assessment; good analytical support; attracting post-docs and guest scientists; good publication output and bibliometric profile (FS); good core funding.

Weaknesses

Lack of clear strategy and leadership; need for strategy for stronger links between food related units at SLU; weak profile in society; uncertain status of food science and safety at SLU; lack of industry involvement; weak recruitment policy; lack of critical mass in some areas; gaps in some critical areas of food science and safety

Relationships between UoA's

No clear collaboration between the UoA's is stated. There is a need for developing synergies between FS and other groups in the biological sciences in particular with the Department of Microbiology related to food safety. The strong current veterinary and public health focus in MFS seems to be a constraint to develop synergies of relevance for the food processing safety area. A research linkage between TFS and FS on safety of bioactive compounds is suggested.

Multi- and inter-disciplinary activities (incl. FOMA)

No clear activities are stated, but there seems to be some collaboration between FS and TFS. FS and MFS have not identified any activity in FOMA. On a general level the cooperation between the units is not strong.

Strategic coordination between the UoA's

The department needs to assess whether gaps in the current programme are to be filled by closer cooperation with other SLU departments, by strengthening or addition of new disciplines to the FS department or by dispersion of the food science programme into other existing departments. The latter option is not one that the review panel would favour, as it would strongly weaken the food science standing at SLU. There is a need to develop a strategy for coordination and cooperation between the UoA's.

Research areas lacking at SLU

Bioscience research related to functional genomics, food chemical composition and structure, consumer focused food microbiology.

Infrastructure facilitate world class research

The panel suggests expanding the platform for in vitro cell model systems and to up-date equipment for cell culture and omics research to strengthen the focus on mechanistic understanding.

Potentials

A closer cooperation and merging with the other units will strengthen food science within SLU. Externally this would make food science at SLU more visible and attractive as partner in national and international projects and thereby attract stronger industrial interest. The present structure of Food Science and Safety should be reviewed. We recommend an alternative internal structure where disciplines (e.g. biochemistry, nutrition, microbiology, genetics) are the basis, as this will improve the scientific strength, increase flexibility and make recruitment easier. It might be argued that the lack of a commodity focus might affect external visibility of the group in industry, but this can be compensated for by other initiatives such as advisory groups, contact persons and increased external activity in general. We suggest an integration process, which is initiated by examining the cooperation potential through projects maps and similar tools, with a wide participation from all units.

Part B: Report on individual Unit of Assessment

Panel 4. Food Science and Safety

Unit of Assessment: 550_1 Food Science

B 1. General assessment of the Unit of Assessment

The current research profile covers Food for Health, Functionality and Technological Quality and Food Analysis. The scope covered is rather broad covering the whole food chain and a number of different raw materials. The general impression is that this is a very active group with a good postgraduate student output and good success in accessing external funds and in collaboration with outside groups. Publication output and quality is very good and well above the international norm in citations. The programme in plant products research is particularly strong and there are also good strengths in characterization and analysis of food raw materials. In relation to the scope of food science research in general there are noticeable gaps particularly in food technology/chemistry and in food microbiology/bioscience and omics technologies. The group appears to be in a period of transition having reorganized its research portfolio from the previous approach which was determined by the division into Dairy, Meat and Fish, Plant Products and Food Chemistry. For this reason it is lacking in strategic focus and direction. There is an urgent need to set out a clear plan for the future direction given the turnover in senior staff that is taking place now and in the immediate years ahead. While individual groups are performing productively the achievement of the highest standards of scientific standing that is expected by SLU will require the groups to reorganize into a smaller number of areas with greater critical mass. The area which has greatest potential in this respect is food for health based on the strong background in plant products research. Some aspects of traditional food quality research in milk and meat attract a low level of industry interest and need to be examined with a view to discontinuation or revitalization through identification of new research challenges or introduction of new research methodologies. In some cases this is already underway e. g. the project on fish oil quality improvement and monitoring of SOPs in feeding fats. A decision is required in relation to the status of food chemistry applied to the study of food structure and rheological properties, which is a noticeable absentee from the programme. This is important for ensuring that research is consumer focused as well as for teaching quality. The department needs strong leadership at this time given the great challenge of setting out a new strategic direction in an objective way. This challenge is particularly acute because of other structural changes that are taking place at SLU, some of which bring threats as well as opportunities to Food Science. SLU should consider the appointment of an external facilitator to help the department with the strategic planning process and with the difficult decisions required for consolidation into a smaller number of research areas with greater critical mass.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - Research

1. Scientific Quality

Originality

Some aspects of the programme are of high international standing and originality. Much of the research in the plant products area falls into this category. The work on the effect of sesamine on fish oil quality is potentially very novel but the mechanistic aspects of this need to be fully integrated into the SLU programme for maximum scientific impact by the SLU group. The large programme in food analysis is beneficial to many projects but the analytical methodologies themselves are in most cases well established and not innovative.

Methods

Much of the research activity seems to be predominantly of applied character with less focus on mechanistic understanding. Notable exceptions are the work on sesamine/fish oil quality and much of the plant science programme. Methods and research equipment are generally adequate and of good international standard. The maintenance of a strong analytical programme in future requires a more ambitious and innovative approach to methodology development. In this respect, the department might consider what role it should play in methodology development connected to the biosciences of food for health research. The strong connections with the primary production give the possibility to e.g. relate data from individual animal or cultivars studies (including genetic information) to final product quality. Methods/equipment needed to couple component analyses to omics information (proteomics, lipodomics, genomics) have been implemented only to a modest extent. The department should consider the new BioCentre as an opportunity to establish an omic platform of relevance to several groups and to access complex analytical methodologies and instrumentation. Analytical methods connected to food structure analysis and rheological properties are also in deficit and a decision on the development of this capability is linked to the comment earlier on the status of food structure research in the future programme.

Impact

The impact of the research is high as measured by citation based indicators (NCS_f, NCS_j, NJCS), with scores significantly above the average for SLU and well above the international norm. A substantial number of international and national invitations as speakers have been listed.

Output

The publication output is excellent and is at the top of SLU performance with more than 500 peer reviewed papers and 47 dissertations (+2 licentiate degrees) completed over 10 years. This indicates a high productivity with more than 3 peer review publications per researcher per year in the last two years. The number of conference proceedings and articles in other journals has also been substantial throughout the period.

Grants

According to the Self Assessment the unit has about 30% external funding through grants. However, it is noted to the panel that the amount of external funding has declined from 2006 to 2008 as appeared in the Self Assessment of the Unit. About 40 % of the funding comes from international funding agencies. The success rate for funding applications is given in the assessment. No funding has been reported for FOMA.

Collaboration

The unit collaborates with a number of national and international universities and institutes

(e.g. wholegrain microscopy with VTT, Finland; bioavailability with Technische Universität München, Germany), and with European and Nordic projects and networks that relate to food and health aspects. Only 2 of these concern EU projects. There appears to be few examples of collaborations that involve a position of international leadership by department scientists.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Major commissions of trust in scientific community:

Engagement with society and communication

This aspect is difficult to evaluate from the given information. We have noted that there are interactions with stakeholders, support for policy-making processes, web-based services and collaborations with developing countries. However, based on the information provided at the time of the review, the number of articles in popular science magazines is low, and articles in newspapers are absent.

National and international recognition

Both the group and individual researchers in the group have been frequently recognised in the scientific community through different assignments, as well as for grants and awards. Several of the professor's are members of academic societies, members of funding boards or act as experts and opponents. The number of PhD students is high. One professor is listed as a highly cited researcher in agriculture. Three researchers are in receipt of an international industrial award.

Visibility

The unit appears to have a high visibility in Nordic networks and partnerships for cereal nutrition in which it plays a leadership role. Otherwise, in a Nordic perspective much of the unit is less visible than their Finnish and Danish counterparts and takes less of a leadership role internationally.

Attractiveness of research environment (infrastructure etc)

The group appears to be well equipped for its current research programme but acknowledges the need for new investment in analytical equipment particularly of an advanced nature. This need should be addressed as part of an overall strategy for programme development in the future. The medium term stability of funding for research is an issue of concern to the unit. The absence of a plan for filling senior vacancies and the general uncertainty about the unit's future structure and location are also issues of concern. The unit is engaged in much collaboration internally and externally. It is difficult to assess which of these reflect major partnerships that significantly contribute to critical mass and scientific impact.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

UoA has a strong position concerning their long and extensive work with plant products, especially cereals. The detailed work with characterisation of primarily vegetable carbohydrates can be of an interesting significance for food industry. However, the work with characterisation must be followed up with more applied studies concerning physiological effects, either within the group or in collaboration with others. The work should be further strengthened if the group developed the work to include effect of various processing techniques, mainly various heat treatments as they are most frequent in association with production of cereal rich food products as bread. It is also extremely important from industry point of view that the results are clear in order to be usable.

The work with folates has attracted some interest but we wish a more dynamic development in this field. We do not see a clear development in this area at the moment.

The milk research is more difficult to evaluate. The group is small with a low activity while a large part of development in milk is more oriented towards product development/product extension while a large part of the Swedish dairy industry has partly moved to Denmark.

On the other hand, this group represents the only milk related research in the country and can therefore be of industrial value although industry at the moment has limited contact with the group.

Fish research has a small importance from a Swedish point of view as the fish industry in the country is very small. The research must be evaluated in relation to competition from what is to be found in Norway for instance.

Meat research has also a low industrial significance although the issues approached are interesting. The distance between research and practical applications are too wide.

Food chemistry, other than component analysis is not pursued with the notable exception of cereal chemistry, in a way to make it possible to evaluate from a user perspective.

The good plant product work has at least European significance even in the long-term perspective. Dairy/Meat and fish are more local due to the small size of the groups relative to dominant groups internationally. The average score will therefore be 3 but for plant products itself 5, Meat and fish 2, dairy products 3.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Group size and strength

The size of the group is adequate and means that it has a good basis to do efficient research, provided that a few priorities are focused on and other tasks are not too numerous. The ability of the group to reorganize into a small number of teams working together to a common research plan is a critical success factor for the future. We do not support a commodity oriented structure for the internal organisation, as it tends to be conservative and rigid with limited flexibility. We recommend an alternative structure where disciplines (e.g. biochemistry, nutrition, microbiology, genetics, statistics) are the basis, as this will improve the scientific strength, increase flexibility and make recruitment easier. It might be argued that the lack of a commodity focus will decrease the external visibility of the group in industry but

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this can be compensated for by other initiatives such as advisory groups, contact persons and increased external activity in general.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

- Identify a clear strategy for the Unit
- Recruit new professors in relation to strategy
- Increase focus on more in-depth research in selected areas and identify a few focus areas aiming for international leadership.
- Seek participation in new EU proposals and assume a more proactive leadership role in project preparation.
- Maintain good connection with primary production and strengthen the focus on mechanistic research including the use of an omic platform related to genetic and production factors affecting final product quality. The output will be critical information for optimising sustainable plant and animal production under changing climate conditions and for optimising cultivars with optimal functionality and/or health components.
- Expanding research in the biosciences on the role of food and bioactives in nutrition and human health including both beneficial and toxicological aspects. In respect of the latter the expertise of Toxicological Food Safety group would be of great benefit.
- Review the deficit that exists in food chemical composition, structure and rheology with a view to ensuring that a better balance exists in the expertise available for industry development and teaching.
- The need for up-dating the scientific techniques and equipment is essential, but the cost may be beyond the scope of most grant programs. It is recommended to review the need for major investments and give preference to the above selected areas.
- More use of modern spectroscopic methods (Raman, IR, etc) should be considered.
- When appropriate, publish in higher ranked cross-disciplined journals.
- The Unit has an urgent need for a clear strategic plan setting out its future programme priorities and the specialisations for its new professorial appointments.

B 5. Additional information

Threat:

There is concern about the continuation of the Food Science group in a single department. This is linked to what could be perceived as a priority focus at SLU on food production and raw material rather than on food processing and the consumer. Such a focus would be out of step with the 'fork to farm' approach taken in most EU countries and expressed strongly in the document Food for Life produced by Europe's food industry.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 4. Food Science and Safety

Unit of Assessment: 713_2 Toxicological Food Safety

B 1. General assessment of the Unit of Assessment

The group leader has a strong record in toxicological research and chemical risk assessment in the food area. The group is relatively small, consisting of 2 senior staff 3 junior and 2 PhD students.

The group is located together with veterinary pharmacology and toxicology group and ecotoxicology group. The group has now three areas of research in their focus:

- Transport mechanisms for chemicals across biological barriers in the body, e.g. intestinal uptake.
- Endocrine disruption, *in vitro* effects of contaminants and other chemicals in food on steroidogenesis and adrenal hormone secretion, using a human adrenocortical cell line
- Developmental toxicity; exploring the zebrafish embryo model for predicting risks in mammals.

The first area is a continuation of a long standing research interest of the two senior scientists, transport of metals and trace elements across biological barriers and influence of essential elements. The second area is a relatively new area of research started by the group leader following a research stay in UK. The last part, the zebrafish model is a new area of research to explore the usefulness of this model to detect compounds in food that may disturb development in humans. No publications have come out of this last activity. The publications from the two other areas are of good quality and aim at studying mechanisms at gene expression level. Their aim is also to use these model systems for hazard identification i.e. screening of compounds from food and this was done using the adrenocorticoid model. The output in terms of number of papers is medium for SLU,, but this is probably due to the fact that there has been a reorientation in the group taking up new research area. Moreover, the group leader has only been present at a 20% basis for a long period and only recently come back on full time. The leadership is good.

The strategy of the group, to narrow their research focus to hazard identification and in depth molecular studies on mechanisms, is basically sound, but currently, the range of topics appears too wide for a small unit. A closer cooperation with food science within SLU and their Food for health area, as well as outside SLU would create opportunities to participate in more food chain oriented work and thereby to attract greater industrial interest and also more research grants. The potential is very good. However, at the moment the unit will need more resources to be able to grow and get more external funding.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Methods

The UoA is oriented towards both hazard identification and molecular mechanistic research focused on three different research areas:

- Transport mechanisms across barriers of chemicals employing *in vitro* models.
- Endocrine disruption, *in vitro* effects of contaminants and other chemicals in food on steroidogenesis and adrenal hormone secretion, using a human adrenocortical cell line.

- Developmental toxicity; exploring the zebrafish embryo model for predicting risks in mammals.

Quality and originality

The scientific quality of the in depth studies on metal transport across barriers; in particular the intestine using several complementary methods including molecular biology is very good. The set up of an *in vitro* model for endocrine disruption of adrenal cortex steroid hormones including effects on expression of key genes in the steroidogenic pathway is interesting. Apparently adrenal-corticoid toxicity has been a neglected area of research; however, the group does not give a clear reason for choosing this particular area of research in relation to food toxicology. The use of this cell line for this particular purpose is not original, but findings that naturally occurring bioactive compounds in foods may affect the adrenal cortex may be of significance. Findings in this *in vitro* model would require confirmation of adrenal effects in animal studies. The zebrafish model has not yet resulted in scientific output, but rapid screening methods may have a future potential for identification of potential reproductive toxicants.

Output

Publications have taken place in recognized toxicological journals and one paper in the top ranked toxicological journal. According to the bibliometric the scientific output is average for SLU and given 3 FTE in research of senior and junior staff and the low FTE of 0.7 in research for 2006 is considered to be medium in comparison with other food toxicology groups, which are often much larger.

Grants

The unit has about 28% external funding, which is limited.

Collaboration

The group has both national and international collaboration, however it is not extensive.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

At the moment the group is small. Reorientation and new activities have been started recently, which is a positive sign of active leadership. At present the group does not have a leading position in its field (food toxicology), but the group leader is a recognised toxicologist and has been a member of a leading European advisory food safety scientific panel and also boards at a national level. Several initiatives have been taken to recruit new researchers from other disciplines and a junior scientist in the group is currently qualifying for a senior position. Visible in international society

On the basis of this evaluation, award a score from 1-6 ²:

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

Foods on the market should be safe from a toxicological point of view. This is the responsibility of the food authorities and the food industry. However, toxicology and food safety is a difficult area for industry and authorities to handle. Food toxicology is a non-productive area as long as nothing happens. The topic can be compared with insurance, as long as nothing happens; the interest in the subject is relatively low. On the other hand, when a problem occurs the media exposure is tremendous with severe negative effects for the company and brand in focus, perhaps even a whole market area as well as for the authorities. In this respect there is a need for trusted independent experts that can assess the situation and advise managers both in authorities and industry as well as the public. The increasing consumer and media interest in food, the effect of food, additives, clean label, healthy eating, the REACH-initiative would therefore form an obvious base for the UoA to have a clear industrial interest. Whereas the industrial interest would most probably be addressed to toxicity of compounds, cocktails of compounds and not to the mechanism behind the toxicity, such traditional black box thinking in toxicology is obsolete. In depth knowledge on mechanistic aspects in toxicology serves together with knowledge on toxic effects of a compound as a very important basis for extrapolation from *in vitro* and animal model systems to humans in toxicological risk assessment. Furthermore, it serves an important basis for development of new testing strategies.

A closer cooperation with food science within SLU as well as outside SLU would create opportunities to participate in more food oriented work and thereby to attract greater industrial interest as well as research grants.

Toxicology is universal and results should have a long-term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy of the UoA is to create a more coherent research environment by continuing to narrow their research area and focus on fewer projects as the UoA is relatively small. Furthermore they want to combine established models with cutting edge technologies such as omics- and iRNA techniques for the purpose of mechanistic understanding of toxicological effects observed. Generally this is a good strategy. However at the same time the UoA wants to maintain their three areas of research, which appear to be difficult to develop to a high level at the same time for this relatively small research group. In addition the UoA has FOMA activities that are related as they use the zebrafish model, but with an ecotoxicological goal the activities by this seem to be further diverted. In the reviewers opinion it might be better to focus on fewer areas and instead develop complementary research models for more in depths studies. For example, if endocrine disruption is chosen, *in vivo* models should be used to confirm *in vitro* findings and models to study inactivation of the steroids and interference with receptors could be included. The UoA collaborates on adrenal toxicity with scientists at

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

Uppsala university, which have a longer record of studies on this end-point. Similar to the endocrine area the UoA indicates that findings in the zebrafish have to be confirmed in other *in vivo* models.

Food chain thinking appears to be common in the EU framework programmes. The UoA at the moment does not participate with their expertise in networks of this sort. It might be an opportunity for the UoA to seek more collaboration within SLU, with for example the food for health research area at the Food Science Department as this area would need to address food safety issues, including kinetics, of “allegedly” healthy bioactive compounds in foods, particularly from plants as there is a general lack of toxicological data on most of these bioactive compounds. The UoA is located together with pharmacology and toxicology and ecotoxicology groups and according to the self assessment they have a fruitful collaboration and share relatively well equipped common facilities. However, it was not clear to the reviewers the scientific out-put of this collaboration.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA is engaged in FOMA activities in the Animal Health programme where the group leader is a coordinator. The UoA is responsible for two FOMA projects, one on zebrafish embryos as a test model for developmental toxicity and one on molecular markers of aquatic toxicology using mainly veterinary drugs in the aquatic environment as test compounds.

A new programme on the Food Chain has also started. It is planned by the unit and the program is intended to include projects on food safety, sustainable environment and animal welfare. Certain issues will be dealt with in collaboration with other programmes, eg the impact of ruminant on climate change with the Climate Programme.

It is unclear to the reviewers how this small unit at the same is able to run these projects and with the necessary strength develop toxicological research within the food safety area.

B 4. Actions for development at the Unit of Assessment

The UoA is currently understaffed as it only has 1.45 permanent positions. Apparently there are no technicians to help with the work in the laboratory. The unit will need more resources to be able to grow and get more external funding. The projects should be part of broader projects (food chain) together with other groups in order to be able to obtain external funding. The unit could for example seek more collaboration with food science and in collaboration seek external funding for projects involving also food safety issues. A clear recommendation in order to promote growth would therefore be to increase the staff above the very minimum

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

The present research activity of the UoA is basic oriented, however, knowledge obtained from the methodology set up for hazard identification purposes has a potential for important contributions in the future. Contribution to society (food authorities and industry) in the form of chemical food safety is to do toxicological risk assessments, which is a skill in itself. Science based risk assessments in food safety for regulatory purposes increasingly take place in international organisations such as EFSA and WHO. Persons eligible for scientific panels are those with broad scientific competence and skills in risk assessment. In this UoA it is only the group leader (which also has experience as a department chair at the National Food Administration) that contributes at this level. In a longer perspective it should therefore be a goal that scientists at the department also develop skills in toxicological risk assessment and participate in such activities in addition to their general toxicological research.

Part B: Report on individual Unit of Assessment

Panel 4. Food Science and Safety

Unit of Assessment: 713_3 Microbiological Food Safety

B 1. General assessment of the Unit of Assessment

The UoA is small consisting of 4 academic persons with 2.4 FTE in research. During the time period under evaluation, the UoA has been lacking a professorship in food microbial safety and thus a real leadership has been missing, which has disturbed systematic development of the unit. In spite of this, the personnel of the unit have been able to generate interesting results especially on epidemiology and risk factors of food-borne bacterial pathogens and water hygiene. The bibliometric profile indicates a SLU-normal performance. The papers have been published in good journals. Although the total number of papers is not high, obviously due to the limited number of research-active personnel, the number of papers and citations per researcher are good showing a marked potential among junior researchers. Similarly the share of the TOP5% papers is good. Furthermore, good networks in the field of food safety have been established at the national and international level. The team members have had an important national and international contribution to food safety practice.

The future focus of UoA is the development of risk assessment and decision analysis. In addition to this important subfield of food hygiene, the unit should develop and strengthen the molecular biological approach including functional genomics which form the basis for the modern food safety research.

The long period without a professorship and the lack of real leadership has hindered the development of the unit. The UoA seem to have very limited resources compared to similar units in other Nordic countries. Effective and quick corrective measures are needed to give to the UoA real possibilities to carry out high quality research and to have science-based impact on food safety in society at the national and international level.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA has focused on risk assessment and epidemiology of infectious diseases and zoonoses and removal of pathogenic microbes from wastewater. The microbes studied include *Campylobacter*, *Salmonella*, *Listeria*, EHEC, *Leptospira* and *Yersinia*. Virology research with the division of virology has been initiated. Research aims of the unit have not been clearly established and they are fragmented, probably due to the lack of professorship and principal investigators in the UoA in the past years. Due to the small size of the UoA the scope of the research area should be better focused. The research should form more coherent entity with good relevance to food safety.

Nevertheless, there are some interesting contributions on epidemiology and risk factors of food-borne bacterial pathogens and water hygiene. In spite of the fact that food hygiene has

strong practical relevance, a more basic-scientific approach would improve methodological expertise of the researchers. Curiosity-driven research needs to be strengthened in the UoA. The methodological know-how at the unit is not sufficiently wide. The narrow scope of the unit's own methodology and dependence on other units' methodological skills limits researcher training and thus impairs the development of food safety research.

The bibliometric profile indicates a SLU-normal performance. The papers have been published in good journals and some of them in high-impact journals. Although the total number of papers due to the limited number of research-active personnel is not high, the number of papers and citations per researcher are good showing a marked potential among junior researchers. Similarly the share of the TOP5% papers is good.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The long period without a professorship and the lack of real leadership has hindered the development of the unit. The research has been fragmented and has no clear profile focusing on single practical food safety issues. No research groups focusing on determined food safety problems have been established at the UoA, which has disturbed the creation of attractive research environment with effective PhD supervision and recruitment of new PhD students. External funding is small. Improvements in the laboratory methodology and investments in modern research equipment are needed to increase the unit's expertise in modern food safety research.

At the moment there are no real prerequisites to achieve the critical researcher mass. The panel is worried about the lack of principal investigators. Quick and effective measures are needed to get food safety research running and to give a platform for ambitious researchers and PhD students. It seems that there has been lack of responsibility at the department and faculty level to complete the reconstruction work of UoA satisfactorily.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group is difficult to evaluate as it is presented as a fairly new part of the new department. However, the area presented gave a clear impression that the focus is mainly in the primary production and not so much on food production. A healthy animal is one base for safe foods. Research of the team members has had a practical orientation. The team members have studied the efficiency of Swedish *Salmonella* control programme and have shown the decreasing use of antimicrobial agents contributing to the low prevalence of antimicrobial resistance in animal bacterial populations compared to some other countries in the EU. There are many steps to follow after the primary production with large effects on food safety which is not considered based on the presentation from the group. The area is very important

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

for industry and the group therefore needs to orient the work towards the whole food chain to be of value for the industry.

By identifying risk factors of yersiniosis in children, tracing the source of a large outbreak of verotoxin-producing *Escherichia coli* and showing genetic diversity of *Campylobacter* strains in humans have improved understanding and given tools for prevention of these pathogens. The team members have a large number of different tasks in society and they strong links with authorities at the national (Ministry of Agriculture, Zoonosis council, SVA, National Food Administration) and international level (EU, EFSA, FAO, WHO, World Bank) being able to launch their results to decision-making bodies. The unit has been active in collaboration with developing countries.

Due to the importance of food safety, including risk assessment, in society, the UoA has a future potential to generate research and knowledge and thus to contribute to the welfare of people.

The team has strong links to national, European and global organizations. This could serve also as good potential for new initiatives in research.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

According to the Self-Assessment the most promising future research directions of the UoA are (1) research collaboration with developing countries (Eastern Africa and Asia) and (2) research focusing on processes important for controlling exposure to food-borne pathogens including risk assessment and decision analysis, stress responses of bacteria, virus diagnostics and the use of bacteriophages as indicators of virus removal in water treatment processes and in the destruction of bacteria in foods.

The UoA should as a prerequisite develop its scientific infrastructure and methodological expertise to ensure future research potential in addition to promoting food safety and research collaboration in developing countries. The establishment of research groups to run research of high quality is needed. The UoA has expertise in risk assessment and decision analysis mentioned in the Self-Assessment. In addition, the unit should develop molecular techniques to meet the challenges presented in the Self-Assessment. Functional genomics more extensively used in the modern microbiological food safety research are needed to generate interesting projects and to increase external funding. However, the UoA should be cautious in promoting new research areas due to the limited number of researchers. The resources in the UoA should be comparable to similar units in other Nordic countries.

Food safety is a central issue in society. Policy in developed countries is directed to support the health of consumers and to guarantee safe foods. This all gives an important background for the development of microbiological food safety research.

On the basis of this evaluation, award a score from 1-6 ⁴:

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

B 4. Actions for development at the Unit of Assessment

- Microbiological food safety research is developing fast due to enormous progress in bacterial functional genomics and proteomics with large number of whole genome sequences available. This development should be exploited in the future research direction of the UoA.
- New PhD students should be recruited and organized post-doctoral training should be established.
- Public health is the main focus of UoA in food safety research. The actions to improve food safety should cover primary production, food processing and consumers. The research focused on food processing is missing at UoA and should be strengthened.

B 5. Additional information

None

Report – Part A: General Assessment of the Research Field

Panel 5. Animal Health

All 12 UoA are part of the Veterinary Faculty. The units provide essential teaching within the veterinary curriculum, according to standard university criteria and the standards applied by the EAEVE (European Association of Establishments of Veterinary Education). Teaching is to be research-based and relies on the criteria of evidence-based medicine. It is planned that the UoA's will shortly move to a new building which will provide world class facilities for future research. The UoA's offer an appropriate breadth of research expertise.

All units assessed have been or will be subject to major structural reorganisations. These changes have presented a number of important challenges, particularly the creation of an independent animal hospital. The new animal hospital has been established with its own administration, reporting directly to the Vice Chancellor. As the team was informed, the intentions behind this measure were to improve the budgetary situation by providing an extra income to the SLU and to allow for more time for research by university staff. While these goals are appreciated, our review suggests that so far they have only been partly achieved. For some staff creation of the hospital has been helpful in that it has clarified their commitment to clinical work or created additional time for research. However, critically for some of the academic staff in the Department of Veterinary Clinical Sciences, access to patients for research and teaching seems to be insufficient, to the extent that the maintenance of relevant clinical skills is endangered. SLU is strongly urged to recognize these problems. One of the solutions might be the creation of joint appointments between the faculty and hospital. A second problem is that some veterinary clinicians, with long experience and high levels of clinical experience, may not be suited to the delivery of cutting edge research, despite their desire to do so and regardless of the fact that more time has been made available for this activity. It is suggested that such staff might be better suited to full-time attachment to the hospital. However, if this change is accepted, it is essential that an appropriate career path is identified for the senior staff who become full-time dedicated hospital clinicians.

In addition there is considerable concern about the physical separation of bacteriology, virology and parasitology from the SVA and a possible change in responsibilities of the SVA. To date intensive cooperation has led to a win-win situation for both partners. A separation may particularly negatively affect the three UoA mentioned above. There is the imminent danger that access to scientific personnel will be drastically reduced to a point, that a meaningful continuation of the present research activities will no longer be possible, e.g. virology. This also affects the provision of laboratory and animal facilities with a need for the highest biosecurity standards allowing work with highly infectious agents. How this link will be managed in the future is unclear; this uncertainty particularly concerns the large number of joint appointments between SLU and SVA. SLU is strongly urged to address this situation in a manner which guarantees the continued functioning of the affected groups and staff holding joint appointments.

Management of the faculty and communication between management and staff appears unclear. In many cases members of the UoA's were uncertain whether existing staff close to retirement were to be replaced and if so when. Hence, succession planning appeared to be

poorly thought through. Staff appeared to be unclear about the University, Faculty or departmental strategies and their role within these strategies. Furthermore, some staff, for example those dependent on animal facilities, were unclear whether these were to be provided in the new building or to what extent. This clearly demonstrates a lack of appropriate consultation in planning and/or communication of the new building design.

The age-structure amongst the senior staff appears very unbalanced, many people are close to retirement; the impression is that many SLU UoA's urgently need new highly qualified staff, with new ideas, and cutting edge skills; in many cases appointments from outside SLU would be of value.

In some instances there appears to be little collaboration or co-operation between some UoA, even between groups with immediate research overlap. Again this suggests a lack of proactive directed management from senior Faculty and Departmental administrators; strategic overview appears to be lacking and in many cases organisational structure appears to be the result of history, choice and chance (ophthalmology in large animal surgery for example). More effective configurations could easily be identified.

It is obvious that one of the strong points on the field of animal health is the involvement of the UoA in diagnostics, epidemiology, pathogenesis and eradication of infectious diseases, particularly in food animals. However, there are no collective research efforts but rather individual approaches by the various UoA. In order to further sharpen the profile and the international standing it is suggested to develop a joint research program involving several UoA and to develop a common methodological platform taking into account most recent methodology on the molecular level and the field of proteomics.

Another area worth a joint effort might be the field of bioinformatics. Several units deal with this field with, however, only little communication. Other universities handle similar situation by forming a centre with some kind of autonomy in respect to develop common research projects and grant applications. Bioinformatic expertise might sensibly be incorporated into the epidemiology group.

'Omic technologies (proteomics, genomics etc.) were mentioned by several UoA's as being important in their work but appeared to lack a central focus within SLU. However, it was difficult for this panel to assess clearly whether this really was the case because the Animal Health units were being assessed in isolation from other research areas in the university.

For any further research specific recommendation see reports on animal health, Template B.

In coming to an end the panel would like to express its pleasure that all the units assessed focus on animal health without neglecting the relations and connection to neighbouring disciplines such as Animal Science and Human Medicine. In maintaining this strategy the Faculty of Veterinary Medicine will maintain its position as a highly recognized partner for stakeholders in the field of production and companion animals and in relation to human health, e.g. zoonotic diseases.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 712_2 Biomechanics and Applied Physiology

B 1. General assessment of the Unit of Assessment

The UoA is rather heterogeneous and in some fields (e.g. genetics) scientific success depends on interactions with other departments/units. The unit provides a platform for joint operations with other units and presently cooperates with large and small animal medicine. It performs in depth research, reaching the scientific community as well as stakeholders and society in general. The UoA is adequately engaged in PhD-education and is successful in acquiring extramural research funds.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA is part of the Dept. of Anatomy, Physiology and Biochemistry and comprises four rather heterogeneous working groups dealing with a) Biomechanics and rehabilitation, b) Cardiovascular functions in health and diseases, c) Fluid balance and temperature regulation and d) Physiology and behavioral parameters to measure animal welfare.

The panel was particularly impressed by the biomechanical studies on the musculo-skeletal system of the horse and the rehabilitation program dealing with animal pain. The UoA was formed about two years ago as a result of restructuring the faculty and department structure; it strongly interacts with other departments, e.g. genetics in Uppsala University, but also other units of the faculty of Veterinary Medicine and Animal Science in SLU.

In the past the unit has competed successfully for national and international funding, their results are published in internationally recognized journals. There is a relatively high citation index and the other bibliometric indicators are strong. The research covers basic scientific as well as applied aspects. The panel views the scientific quality, as presented in the self evaluation document, as internationally recognized and suggests that the subgroup dealing with biomechanical aspects in the horse should aim for publication in higher ranked journals.

The panel supports the strategy of the unit to create a common research-platform, to reduce the heterogeneity of the research topics and to be more focal. With the retirement of Prof. Olson, an important person involved in research, theme c has been lost and the panel wonders, whether this subject can be pursued to the same extent as in the past. This concern about the future of research theme c was highlighted by the lack of recent publications in this area and the fact that during the meeting this subject was only mentioned by the members of the UoA when asked directly.

Representatives of the UoA talked about the creation of research projects involving all subgroups of the UoA to further strengthen their research potential and outcome.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Particularly in respect to biomechanics of the horse, the UoA provides leadership on a national and international level, it also interacts strongly with society. The research on fluid balance is interesting from a scientific point of view and could be of relevance for developing countries with arid climatic conditions. The animal welfare and behavioural research performed by the UoA is recognized but less prominent. For the time being it is too early to comment on the scientific input of the LUPA project, since the UoA is one of many participants.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research topics addressed by the UoA are of a potentially high relevance and impact to society. This is demonstrated by the results of the horse biomechanical research, where spin offs in respect to improved objective clinical diagnostics can be expected. Also the LUPA project has a great potential, but it is too early to give any further comments.

Research on fluid balance in goats may be of some interest for agriculture in arid climatic conditions.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

There is no doubt that the research addressed by the UoA has a high potential for further improving animal but also human (LUPA-project) health. The UoA is encouraged to seek a wider cooperation with the clinical units of the SLU, particularly in respect to research on animal welfare, pain and behaviour but also biomechanics.. The group seems to be highly motivated, however, further success will depend on adequate replacement of the academic staff already retired or going to retire.

On the basis of this evaluation, award a score from 1-6 ⁴:

*note this score relates primarily to the strong biomechanics theme, but less so to other research areas.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The members of the UoA must strengthen intra unit communication and cooperation and also further improve cooperation with other departments of SLU. Its strategy should aim towards a more focused research program.

B 5. Additional information

The UoA provides essential teaching in the veterinary curriculum. Adequate staff levels, including technicians, must be maintained to allow for both teaching and research.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 713_6 Bacteriology

B 1. General assessment of the Unit of Assessment

The UoA covers a number of diverse topics in bacteriology, e.g. *Treponema* and *Brachyspira*, spore forming bacteria in biogas plants, adhesins in *Staphylococcus*, waterborne pathogens, *Clostridium difficile* and *Helicobacter pylori* in cats and dogs. Some of the topics are the subject of in depth research which is of international visibility, e.g. the *Treponema* and *Brachyspira* work. However, due to the number of different subjects that are under investigation the panel had some difficulty in identifying a clear research profile for this UoA.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

There is some important hypothesis driven research going on in the *Treponema* and *Brachyspira* field, which is embedded in an excellent national and international network of competent laboratories. The overall scientific output of the unit is good, both in terms of number and quality of papers. The numbers of PhD students which have graduated from the unit is pleasing and appropriate. The UoA has attracted a satisfactory level of external funding through competitive national research grants.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA's work on *Treponema/Brachyspira* has gained national and international recognition and has been awarded with two local prizes for its publications. This research theme has a major significance for the livestock sector, and the group has an excellent expertise in this field, including the (difficult) cultivation of these organisms. In addition, there is substantial expertise in the genetic characterisation of bacterial organisms. However, at the level of the entire unit a clear focus on important research areas is missing.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The research of the UoA and the knowledge created is relevant for the livestock sector and for public health. The research on *Treponema* and *Brachyspira* is well established and is undertaken in collaboration with other leading laboratories in Sweden. It might ultimately have a high impact, contributing to the control of these infections in the national swine population. This would considerably improve animal health and welfare as well as profitability in the swine farming sector.

The other research activities of the unit are more discrete with a varying relevance for animal and public health and in general are of a lesser impact. It is perceived as a problem that these research efforts are not supported by an adequate critical mass in terms of personnel or national or international collaborations.

The dimensions and the impact of the bacteriology research group are primarily of national impact.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future of the UoA is unclear since the major professor retires within the next 24 months, and apparently no decision has yet been made on his successor. In addition, since there are only three permanent staff positions there seems to be little realistic prospect of establishing a sustainable strategic plan over the next few years. The present low external funding also makes this problematic. This situation probably contributes to the diversity of research topics. Another factor of uncertainty is the future relation of the UoA to the SVA unit of bacteriology. Apparently the successor of the major professor will also be a 50% appointment with SVA, however, it is not clear how the move of the SLU bacteriology unit to a new building and the restructuring of SVA will affect this working relationship.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Some of the research projects have environmental implications, e.g. water-borne pathogens.

B 4. Actions for development at the Unit of Assessment

There are some very good scientists in the UoA. However, they need a mid to long-term perspective. Due to the small size of the unit, concentration on fewer topics, targeted

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⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

recruitment of PhD students and a more intense national and/or international cooperation would seem to be essential. The UoA might sensibly concentrate its efforts on the research in *Treponema* and *Brachyspira* at the expense of minor research areas, thereby strengthening the national network in this area. In addition one or two more fields of public health relevance could also be continued.

B 5. Additional information

Bacteriology is one of the key disciplines for Veterinary Medicine at SLU and action should be taken to strengthen it. The position of the professor should be filled as soon as possible after the retirement of the incumbent. With respect to the small size of the SLU group the organisational link to SVA should be maintained and strengthened otherwise there would be insufficient critical mass for adequate future research.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 713_7 Virology

B 1. General assessment of the Unit of Assessment

Virology is a very active UoA with a high national and international profile. The main strength of the unit is the application of advanced molecular detection techniques for a range of viruses, in particular agents causing dangerous transboundary and/or zoonotic diseases. The unit's international achievements have been recognized by the World Organisation for Animal Health (OIE) by nominating the UoA as a Collaborating Centre for "Biotechnology-based Diagnosis of Infectious Diseases in Veterinary Medicine".

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The unit has an excellent international reputation and belongs to the world's leading laboratories in its field. Most of the scientific results have been published in journals with high impact factors. Much of the research is needs-driven and a primary goal of the unit is the diagnosis of dangerous infectious agents as early as possible using the latest nucleic acid detection techniques. In addition, SOPs for diagnostic techniques were developed for the OIE and these are applicable in developing countries. Hypothesis-driven research has yielded remarkable results having a significant international impact, e.g. in the field of pestiviruses. The unit has had a good record of successful PhD students and PhD students continue to be an asset for the research work. The external funding is above average, including highly competitive international grants. The unit head has acted in several EU funded projects as coordinator or as a partner. The unit cooperates well with a large number of international research groups and institutions.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit's leader is an internationally recognised scientist who is currently the president of the European Society for Veterinary Virology (ESVV). He has been awarded prestigious national prizes and he is frequently invited as speaker at international conferences. His expertise is

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

welcome in international advisory bodies, e.g. OIE.

Scientists from the Virology unit cooperate well, both within their UoA, as well with other SLU institutions and industrial partners.

The director of the virology UoA provides strong leadership and he has clear and focused ideas for the future development of the unit.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The unit's output must be considered as highly relevant for society since rapid diagnostic techniques will help to fight dangerous infectious zoonoses or animal diseases more effectively. Legislators and risk managers will benefit from the UoA's research, since the availability of modern molecular detection assays is crucial for disease control protocols. They are prerequisites and optimal tools for the eradication of notifiable exotic diseases and the reliable detection of zoonotic agents in animals and their products. Some of the assays developed by the unit have a commercial potential. Simple but effective diagnostic tests have been developed and transferred to developing countries.

The UoA has a very strong international impact in the veterinary and public health field.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The research conducted within the Virology unit covers a relatively large number of infectious agents, but with differing intensity. Research goals are clear and realistic. The group is well guided and strong and most researchers have different national and educational backgrounds. This ensures a creative mix and a positive atmosphere in the unit which is a prerequisite for innovative research. Provided the present recruitment and funding strategy are continued the unit possesses great future potential.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

It seems unlikely that the present level of research can be expanded any further unless there is greater investment in personnel by SLU.

B 5. Additional information

Only 1.5 staff positions are permanently funded by SLU. The assessment panel is very concerned that this fragile personnel situation might suffer after movement of the SLU group to new buildings or after a possible reorganisation of SVA, respectively. In addition, a substantial impediment for the UoA is the lack of animal facilities with a high biosafety level; as a result, animal experiments with relevant infectious agents cannot be performed.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 713_8 Parasitology

B 1. General assessment of the Unit of Assessment

Parasitology appears to be a strong, broad-based UoA, with a good international reputation. They have competency in a range of disciplines from traditional taxonomy and parasite identification through to molecular phylogenetics, with particular strengths on pasture-borne parasites of cattle.

This UoA, working in collaboration with SVA parasitologists, form a group known as SWEPAR, which has a strong international identity with a high profile and recognition in the field of parasitology. Efforts must be made to preserve and build on this reputation, despite the challenges of new organizational structures.

Both fundamental and needs-driven research of high practical relevance is undertaken. The UoA has a good record of grant income generation and a high success rate of funding per application submitted. The number of graduated PhD students over the last 10 years is commendable.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific work undertaken and the methods employed are appropriate, the quality and reliability is good (as evidenced by the bibliometric data), although it is difficult to identify any one research area in which this UoA has unique expertise.

The record of this UoA in successful PhD student completion over the assessment period is above average and the publication rate is also appropriate to the number of staff. Some of the selected publications are in the highest impact factor journals within the field of parasitology, for example the International Journal of Parasitology. The UoA has a good record of national and international (EU) grants.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA, particularly from within the SWEPAR constellation, provides strong and effective leadership in Nordic parasitology. The SWEPAR web site provides a useful point of contact for other professionals and the public.

The facilities in the new Faculty building will present a good environment for research and numerous opportunities to strengthen the microbiological element of the work undertaken.

The UoA is clearly a valued international collaborator, as indicated by ongoing EU-project and COST programmes.

There is excellent evidence of demand for the advice and expertise of members of this UoA from, for example, members of the public, SVA scientists, the Swedish Animal Health service, Swedish Dairy Association and various biotech and pharmaceutical companies.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The parasitology UoA undertakes research with a good level of societal impact and has been sought out by industry partners for collaboration, as demonstrated for example by recent work with the Swedish Egg producers. Parasiticide trials have been commissioned by industry providing valuable additional income. Professor Høglund was asked by Merial Animal Health to contribute to a European parasitology group to draw-up guidelines for European large animal parasite management.

The unit undertakes research both of value to Nordic countries and within a wider European context. The UoA, particularly from within the SWEPAR constellation, provides strong and effective leadership in Nordic parasitology.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

There are clear and realistic plans for the future, particularly in relation to the effects of climate change on parasites and parasite management and parasite resistance as distinct from treatment failure. Although future plans remain broadly framed this allows the UoA to respond opportunistically to funding possibilities as they arise.

This is a group of relatively young researchers, in which the gender balance appears equal.

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The opportunities exist for a great many collaborations within SLU.

On the basis of this evaluation, award a score from 1-6 ⁴:

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

At present, the staff are excellent generalists, without dominating any particular area of veterinary parasitology. While this strategy has positive attributes, for example better positioning the UoA for opportunistic grant applications it does not facilitate subject-specific recognition.

B 5. Additional information

It would be of value to the UoA to receive clarification relating to whether Prof Arvid Uggla, currently serving as Faculty Dean, is likely to be replaced.

Care should be taken that the restructuring of the organizational relations between SLU and SVA will not affect the research environment of the UoA.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_1 Small Animal Surgery

B 1. General assessment of the Unit of Assessment

The current research profile of this UoA is markedly focused on urogenital disease of the dog. Other areas of interest include orthopaedics, oncology and neurology. While there are clear advantages in maintaining some level of focus to the research of the group the danger of the area of urogenital diseases being over-emphasised to the detriment of other areas of the discipline of surgery is real.

It is pleasing to see this potential problem being addressed with the UoA's excursions into research in the areas of musculoskeletal disease, neurology and comparative oncology, especially as this appears to be occurring through increasing collaborations within SLU and Uppsala as well as nationally and internationally.

However these new areas of endeavor are in the very early stages of development and will need strong and focused leadership and nurturing to insure they develop into sustainable areas of research strengths.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- There is unarguably expertise & opportunity in a range of uterine diseases and members of the UoA have used this opportunity to document prevalence and severity of a range of disorders effectively. The material has been well performed and provides interesting information about canine urogenital disease. However because of the unique nature of the Swedish canine population the results of this work have perhaps not penetrated the literature more prominently than they otherwise would have and are less relevant to other canine populations. The real potential here is for collaborative work with other similarly minded researchers to compare and contrast the characteristics of urogenital diseases in populations where the practice of neutering is much greater.
- There is unarguably an opportunity to develop a range of skills to improve the recognition and management of a range of small animal musculoskeletal diseases. However it is far too early to tell how this will happen and how likely it is to happen.
- There are aspirations within the UoA to develop neurological and dental research. However, the neurological activity is limited and there is minimal evidence to suggest this is achievable in dentistry.

- Comparative oncology may provide an excellent opportunity for collaborative research; however, this is as yet unrealized. Unfortunately, the expertise in this area is concentrated almost solely within one individual who is now only employed as a 20% FTE. Additionally there seems to be some doubt as to whether their expertise in this field will be replaced with a similarly focused individual or the salary used to employ a more teaching focused individual.
- While this area of research offers a clear choice of methods etc and opportunities for increased collaborations within the department, SLU and nationally, however, it certainly does not appear to be at the heart of the UoA's activities.
- While this UoA have produced a number of excellent publications these have been either in the field of comparative oncology or more debatably, urogenital disease. The panel feels comparative oncology offers an excellent research opportunity for the UoA which should be seized if at all possible. The UoA's research in urogenital disease is not of the same quality nor does the panel believe it has anything like the same potential.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Given the current situation there appears to be no or at best a minimal likelihood for this UoA to act as an independent and trusted source of opinion for the general community.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

- Significant potential to identify appropriate questions germane to the canine population to which they have access.
- The group has excellent collaborations with major national stakeholders and it is pleasing to see they have been utilising these collaborations with increasing frequency.
- The gait laboratory provides a real opportunity to look at diagnostic and therapeutic opportunities with objective data. It is, however, very early in its development and as such extremely fragile and will need to be nurtured carefully.
- There is an interesting opportunity for innovation and commercial exploitation with an absorbable "suture device".
- On the basis of the above observations relevance and impact could be considered moderate.

Regional and national impact

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

- The idiosyncratic nature of the Swedish dog population – a high proportion of intact, pure bred animals many of which are insured, together with SLU's concentration of small animal diplomats represents exceptional opportunities for developing clinical research in companion animal veterinary science. The resources at SLU in terms of "bricks and mortar" and equipment would appear to be adequate. However, for this potential to be achieved there is a clear need for staffing levels to be clarified and stratified insuring the boundaries between clinical service work & rotational teaching are clearly established and not allowed to interfere with protected research time.
- There is some evidence of an attempt to diversify the spectrum of research. This is very much needed as currently the heavy emphasis on urogenital diseases tends to dominate activities.
- There is clear evidence of the development of orthopaedic expertise with facilities to match although it is early in its development and will need to be managed. It seems reasonably likely that this will happen as there are clear and likely to be sustainable links with the S&M unit in UoA 712_2.
- There is significant potential for high quality translational research through the Centre for Comparative Oncology although the reality would appear to be that this is because of one person who is now only employed as a 20% FTE. It seems unlikely this Centre can develop to be a strength of *this* UoA's strategic development without this individual's expertise, drive and vision being replaced or enhanced with strategic further appointments.
- There has been a pleasing development of PhD students in the main areas of interest however the impression is that this is not an ongoing phenomenon

On the basis of this evaluation, award a score from 1-6 ⁴:

2

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

N/A

B 4. Actions for development at the Unit of Assessment

There needs to be a commitment to continue the UoA's current expanded research profile – in particular the continued development of the Comparative Oncology Centre and the objective evaluation and management of small animal musculoskeletal diseases through, hopefully, computer simulation and mathematical modelling.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Additionally the opportunity to work with groups outside Sweden to evaluate the impact of non-neutering on disease prevalence and characteristics should be strongly considered.

Information from these studies could then inform decisions on national canine health policy with particular reference to neutering of bitches.

B 5. Additional information

- There is a clear need for staffing levels to be clarified and stratified insuring the boundaries between clinical service work & rotational teaching are clearly established and not allowed to interfere with protected research time.
- For this to be achieved it seems likely that resources will need to be allocated to these duties such that the UAH pays pro-rata for the time academic spend in the hospital generating clinical income.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_11 Reproduction

B 1. General assessment of the Unit of Assessment

This is a unit with a long tradition in both research and teaching of animal reproduction at SLU. The research area, reproduction, has had and still has a key role in maintaining a profitable animal production industry. The unit has been relatively large and strong in relation to both staff and funding, for instance having their own animal facilities. The unit's excellent consistent track record in obtaining external funding and producing PhD students reflects their high standing historically and the panel could see no reason why their productivity should not continue.

The research profile of this group has covered a wide spectrum of comparative reproduction, with strong interdisciplinary approaches. While the group describes the majority of their work as applied research with a strong clinical focus, predominantly in the bovine and swine, there is also clearly expertise in elements of basic research.

Collaboration of the group within the faculty and with other partners within a network of reproductive biologists has been extensive; while the unit has well-established cooperations with a number of developing countries. The unit is well equipped and has levels of competence within a range of biotechnical methodologies.

As a result of the retirement of some senior group members, as well as the reorganization of the faculty, the size of this group has decreased, and the group has lost its animal facilities.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This group has a high international reputation. They have shown excellence in several areas of reproduction. Research on andrology and reproductive biotechnology has been strong, with a focus on *in vitro* studies related to oocyte maturation and IVF. Diagnostic methods for measuring reproductive capacity and health have been developed. Another area of research focus has been female reproductive health and endocrinology.

The panel of methods used in the research is broad and up to date; the group has introduced novel methods e.g. for quality assessment and cryopreservation of sperm and oocytes. Many of the research lines have contained interdisciplinary aspects and have resulted in successful collaborative research.

The group has been very productive for a long time with an excellent track record of producing a large number of PhD students. The publication record of the group is very good as is their bibliometric analysis. The proportion of external funding is extremely high,

reflecting a very successful research strategy.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The group is internationally recognised for its work in a number of fields of animal reproduction including spermatology, andrology, AI, gamete - genital tract interaction and bovine gynaecology. The research environment has certainly been attractive as so many PhD students have been educated. The group has high international recognition and it has been a leading force in the development of ESDAR. The group not only has a high profile in the scientific community but also in general society, as several members hold academy fellowships, have engagements with international bodies, public authorities, and industry. Many of the unit's members have received awards and prizes.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The wide spectrum of applied research of the unit has an impact on animal health and productivity, and the results have had significant practical application. Additionally, basic research conducted within the interdisciplinary network has a wider perspective. Industry has no doubt benefited from close collaboration with this unit. The unit has significantly contributed to the development of the field of animal reproduction in the context of scientific as well as professional education. The future potential of the unit is evident, although it has challenges in the changing environment. The relevance of this research area remains high.

Global

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The overall strategy of the UoA is to carry out the highest quality investigation of reproductive disorders of both clinical and economic significance. The UoA aims to achieve this through an holistic physiological approach with a balanced *in vivo* and *in vitro* methodology.

There is evidence that the increasing demands being placed on production animals is having detrimental effects on their reproductive performance. The UoA believes a detailed

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

understanding of these phenomena in the areas of andrology, female reproductive health and udder function and health will make important contributions to the effective management of these phenomena.

An additional area of research is the impact of environmental phenomenon on reproductive function and health of both domestic and wild animals.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

This UoA is only now moving into this area and while their aspirations are laudable and indeed exciting it is far too early to say whether this will be successful or not. However the members of the UoA are highly respected scientists with an excellent track record in high impact research, thus there is good cause to be optimistic.

B 4. Actions for development at the Unit of Assessment

The UoA are to be commended on the breadth and depth of their collaborations. They are clearly skilled in developing synergies to facilitate the principal goal – holistic trans-disciplinary research focused on the biology of the reproductive system. The challenge for the future will be to insure these aspirations are achieved through effective on-going activities including external funding and succession planning.

B 5. Additional information

There is a need for effective succession planning to insure maintenance of a critical mass of focused researchers – both junior and senior appointments, within the UoA. Given the new direction of the UoA perhaps consideration needs to be given to importing expertise in environmental biology.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_12 Epidemiology

B 1. General assessment of the Unit of Assessment

This is a relatively new unit with a small number of permanent staff, although with an excellent number of PhD students.

The overall impression is that the UoA lacked strategic focus and was not addressing sufficiently challenging epidemiological research questions. While the large databases available provide excellent opportunities for research, there was some concern that too much of the research effort appears to be spent on the necessary but relatively routine validation of the data rather than on the more academically challenging use of these data to test hypotheses. However, this may have been an unfortunate impression created by the way the work of the UoA was reported.

While the members of the UoA pointed out that the group lacked real mathematical or statistical expertise, it was difficult to detect how the UoA were attempting to mitigate these deficiencies through collaboration with subject-specific experts elsewhere.

Although the “mission” of the UoA stated that it was to “Perform state of the art population based research topics relevant to animals, people and society to facilitate pro-action/prevention” little clear evidence was presented either in the self-evaluation or the discussion to indicate which state-of-the-art techniques were being used or how they are being applied to facilitate preventative action. Hence it was difficult to see how the mission statement the UoA was being achieved.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The members of the UoA see themselves as providing a “bridge” between other research groups, offering biological and analytical skills in an applied veterinary context. However, although they clearly collaborate widely within SLU, they argued against the idea that they might offer a role as a general service provider to the veterinary research community at SLU.

As stated above, little evidence was presented to describe the epidemiological methods in which this UoA specializes or its specific areas of expertise.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

This UoA, as presently configured appears in a weak position to provide epidemiological leadership within its immediate Swedish or Nordic context, and no ability to do this in a wider international framework.

The UoA suffers from being, to some extent, in competition with the larger epidemiology group at SVA.

It appears that this UoA is not in a good position to compete with the benchmarking groups identified in A2 (ii) of the self assessment.

The level of grant funding is good, with.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The work of this UoA in its present configuration is of relevance as a service provider within SLU and in a local context, because the UoA members have numerous SLU collaborations and collaborations with other Swedish bodies, such as the Swedish Food Safety Authority, the Swedish Dairy Association and the Agria Insurance Company. The UoA does have potential to expand rapidly in the future, but would probably require investment in new personnel to realize this potential.

As a relatively young UoA, it is not yet in a position, or sufficiently specialized, to compete nationally, and particularly not internationally.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

In discussion, the questions that were identified as potential future foci of research (metabolic stress in dairy cows and surface effects on horse injuries), while clearly of some interest in themselves, appeared somewhat lacking in epidemiological rigour or challenge.

Their role in helping to integrate evidence based veterinary medicine into the curriculum could be strengthened.

Without new appointments in key areas it is difficult to see how the evident potential of this UoA might be realized.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA should use the wealth of data to which it clearly has access to ask more penetrating questions of fundamental significance.

This UoA appears to be caught in a dilemma, with its present level of expertise, it is unlikely to be able to compete for grant funding internationally. In the future a key strategy therefore must be to attempt to collaborate with existing high expertise epidemiology groups, while it develops appropriate level of core skills.

Epidemiology is clearly popular with research students and can be undertaken relatively inexpensively, offering considerable opportunity for development of the UoA with appropriate scientific direction.

B 5. Additional information

Veterinary Epidemiology is an essential component of the veterinary curriculum and has developed rapidly as a discipline over the last 15 years, probably faster than most other paraclinical disciplines.

At present while it is evident that this UoA offers valuable expertise in database management to a range of other research groups within SLU, it requires the appointment of one or more high-level subject specialists to achieve its potential

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_13 Clinical Diagnostics and equine, porcine and laboratory animal medicine

B 1. General assessment of the Unit of Assessment

The UoA encompasses four more or less independent working groups or subunits, Clinical pathology (SU1), Equine medicine (SU2), Porcine medicine (SU3) and Laboratory Animal Medicine (SU4). All subunits are embedded in the veterinary curriculum with their own, specific teaching obligations. Similarly they have their own specific research profiles not allowing an amalgamation in respect to the requested evaluation. While SU1 has a comparatively low research profile, this does not apply to the other SUs. The whole UoA seems to be attractive for PhD-students.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

SU1: Research activities of this SU result from service activities and the attempts to adjust methods developed for human medicine to veterinary purposes. The unit is also heavily involved in providing services in diagnostic imaging. This is without question an important matter, however, it does not leave much time for research, in particular hypothesis driven research. Consequently the scientific quality of this SU can not be on the top and is graded with (2).

SU2: This unit has a well defined research profile and focuses on two lines: respiratory and infectious diseases in the horse. It applies new sampling techniques and analytical methods, research is dependent on patients as experimental horses are difficult to obtain. Performing this type of research requires extreme cooperation with the horse owners. So far the UoA has been able to maintain adequate funding and is fairly optimistic that this situation can be maintained. Research has produced a significant number of papers published in internationally recognized journals and is undoubtedly internationally recognized. Grade (4).

SU3: This group has a longstanding and highly focused research profile on infectious diseases in swine affecting gastro-intestinal function. Funding to date has been adequate however, the UoA is afraid that the new funding strategy of FORMAS might affect its ongoing monetary support. The group was able to produce a substantial number of papers published in internationally recognized journals, allowing the panel to classify their research as being internationally recognized. Grade (4).

SU4: The research activities of this unit are focused on muscle metabolism and the creation of pig models of relevance to research on diseases in the pig and human. Within this spectrum the unit offers a platform for cooperation within the faculty of veterinary medicine, for example on the effects of anesthesia on muscle metabolism, and – with the pig model - on an international level. The unit is able to place its papers in internationally high ranking journals, allowing a grading of 5.

On the basis of this evaluation, award a score from 1-6 ¹:

SU1	2
SU2	4
SU3	4
SU4	5

2. Recognition and Leadership

While a leadership and recognition within the scientific community is not easily seen for SU1, the situation is different for SU2, 3 and 4. For SU2 and 3 this becomes obvious from the involvement in various national and European commissions and, in particular for SU3, the number of invitations to international congresses. SU4 is represented in various national and international boards and academies; the pig model attracts researchers from other countries. For these three subgroups recognition and leadership can be considered as good (4).

On the basis of this evaluation, award a score from 1-6 ²:

SU 2,3 and 4:
4

3. Relevance and Impact

SU1 is developing and adapting new diagnostic tools which are of relevance for veterinary medicine. However, as these activities are rather scattered and given the low visibility of SU1, the relevance and impact seems inadequate for a university research establishment (2).

SU2. This group is engaged in work which is very relevant in clinical horse medicine. It is of high relevance for the horse industry not only in Sweden but in a global sense (4).

SU3: Swine production has a high impact for society and consequently the successful research is of high relevance, e.g. on spirochaetal induced diseases. Hence, the impact can be considered as high (5).

SU4. The provision of a platform on muscle physiology is of a high scientific value. However, the theme it is somewhat isolated and without clinical collaborations, and therefore seems to be of less immediate relevance to society. On the other hand, the provision of a

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

model for research in swine and human diseases could be of a high relevance and impact, particularly in respect to human health, for example allowing progress in the treatment of human diabetes. Though this is still an emerging model, it holds future promise (4).

On the basis of this evaluation, award a score from 1-6 ³:

SU1:2
SU2:4
SU3:5
SU4:4

4. Strategy and Potential

Undoubtedly the UoA has a great potential to facilitate further progress in animal but also human health. While there is no strategy visible in SU1 to achieve this goal, SU2, 3 and 4 have developed clear strategies involving younger staff and by seeking to maintain the current functioning following retirement of senior staff.

The unit is generally satisfied with the time which has been liberated for research due to the creation of the new University Hospital but point to the fact that this has also contributed to a decline in the critical mass of scientists. The UoA is still very new, and has not felt that it had time to develop a more unified strategy - which is essential for their long term survival. There seem to be still unused potentials to make better use of the physical and academic resources available at SLU by intensifying cooperation between corresponding UoA's.

On the basis of this evaluation, award a score from 1-6 ⁴:

SU2,3,and 4: 3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

To seek for better cooperation within the SLU

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

The team was informed during the hearing with members of the UoA, that the unit had been severely hampered in the past years by the reorganization of the SLU. SU4 for some time seemed to have been without any working facilities; however, the situation has now improved. Such situations certainly interfere with the development of excellence that SLU is seeking to achieve. There seems to be an immediate need for access to research horses for one of the units in order to maintain their hypothesis-driven research.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_2 Large Animal Surgery

B 1. General assessment of the Unit of Assessment

The research of the unit Large Animal Surgery indicates activity in a large number of areas including electrophysiology of the retina of all species, equine immune responses to insect bites and immune-pharmacological modulation of sarcoids, pharmacokinetics of various drugs, muscle function during work, magnetism and anaesthesia, air and blood flow measurements, aseptic inflammatory diseases including laminitis and endotoxin associated diseases, equine orthopedics, including methods as biomechanics and thermography, osteoarthritis, hoof diseases, oral diseases and antibiotic resistance.

Neither the panel nor disappointingly the members of the UoA, could identify a strategic focus for their research.

The panel was convinced the broad range of topics presented by the UoA was an unachievable goal for a large animal surgical research profile. Whilst there are undoubtedly excellent opportunities for a research focus in the clinical discipline of this UoA (equine orthopedics, anaesthesia, aseptic inflammatory conditions) these have not been emphasized and furthermore surprisingly, other topics which appear to be misplaced have some prominence.

The panel got the impression of a hard working group of dedicated and creative clinicians, whose interests seem not to be primarily in the area of research. The unit acknowledged that the recent reorganization regarding the University Hospital had liberated research time. However the protracted period without an academic leader with both research and clinical credentials **in the discipline of LA surgery** has almost certainly hampered the ability of the group to create a research focus and form a strategy. Any expectation of improvement in this UoA's research performance is absolutely dependent upon the appointment of a suitably qualified and competent academic leader.

Notwithstanding the above, effective synergies seem to exist between this UoA and certain other units and the UoA has managed to maintain or contribute to a pleasing output of PhD students.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Although this UoA has produced some excellent publications, there are not many of these and the overall scientific quality of the individual papers produced in the group is very

heterogeneous. Furthermore it appeared the UoA's contribution to many papers was peripheral and the bibliometric analysis was unfavorable.

The scientific output may be seen in the perspective that the group has less than 3 FTE for research, and that the FTEs are spread between high numbers of staff. However, the output within those topics traditionally perceived as large animal surgery subjects is considered to be low and scattered.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit does not contribute to the scientific debate in its field. However horse organisations and others appreciate their clinical services.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The horse industry in Sweden is large and growing. Thus the unit possesses the potential to facilitate this process.

The unit is very fragile and fragmented and lack of research direction inhibits the impact of the group.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Surgical disciplines are imperative in an animal hospital. Therefore the unit has inherent potential to be a driving force within the new animal hospital. However, in order to gain status as an acknowledged research group, a realistic research strategy focusing on the discipline LA surgery needs to be developed. While the panel recognises the qualities of the ophthalmological expertise present in the group, this cannot be the only area of research focus for a LA surgical unit.

On the basis of this evaluation, award a score from 1-6 ⁴:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

not applicable

B 4. Actions for development at the Unit of Assessment

While the UoA must develop its own strategy towards a research profile, at the same time the University Hospital should develop an unambiguous strategy of its own to allow for “patient based” research. In the UoA the position of a Professor has been open for a long time. Its filling could be the onset of a new strategy.

Ideally the strategic vision also would contain a long term plan for the recruitment of professors within the traditional fields of veterinary surgery thereby maximising the chances of synergistic development of both specialized clinical activities and research based in the disciplines of LA surgery.

It therefore seems likely the plan would include a focus on both the education of clinical researchers as well as specialists with profiles suited for hospital positions. The panel finds it important that this education is undertaken in close collaboration with research educated staff of the clinical units. Permanent positions with emphasis on clinical skills (including clinical professors and associates) should be described for the clinics in order to maintain highly skilled clinicians within the system for the benefit of all, including the researchers. These positions should be flexible and complimentary to research positions.

B 5. Additional information

The Faculty should utilise the opportunity afforded by the building of the new animal hospital to enhance not only the teaching but also the research strategies of the relevant UoAs.

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_5 Ruminant Medicine

B 1. General assessment of the Unit of Assessment

The unit of ruminant medicine is of reasonable size with two professors. The focus of the research of this UoA is on applied research. The unit has for a long time concentrated on infectious diseases mainly of viral and protozoan origin, which are relevant topics. The professor of ruminant medicine has been the driving force in research on viral diseases. The group has created an excellent network to facilitate their research, with many national and international collaborators. Research into other areas of bovine medicine has been limited, although recently the unit has received funding to study risk factors for metabolic diseases and for EHEC research. The unit has a relatively narrow research focus although as a consequence the scientific quality has been high. The productivity of the unit has been high and the unit has an international reputation.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The unit has been very successful in their selected focus areas of bovine medicine i.e. infectious diseases of cattle. Two strong research lines can be distinguished: viral and protozoan diseases in the bovine. The unit has a strong focus in diagnostics, pathogenesis, control and eradication of infectious diseases in cattle. The unit has created an efficient network and collaborates with many national and international partners. The panel felt the unit could benefit from closer collaborations with the Animal Hygiene unit in Skara where large amounts of field material would be available. Molecular epidemiological and other methods used by the unit and its collaborators are innovative and up to date. They have been efficient in educating PhD students. The publication record of the group is good as is their bibliometric analysis. The nature and quality of the unit's research has meant they have been able to publish in journals with higher impact factors than is usual for bovine medicine-based research.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The group is well recognised in its research area. It has been the driving force in the eradication of BVD from Sweden, as well as in controlling other infectious diseases in cattle. The unit has created an attractive research environment which is reflected by the high number of PhD students. The leaders of the two research themes are active in many networks and platforms and seem to be trusted partners for international bodies, public authorities, and industry.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The units work on BVD is unique. The results of this research have not only been the driving force behind the successful BVD-eradication program in Sweden but have directed similar eradication programmes in other countries. The work has generated scientific knowledge which is useful globally, not only for controlling BVD but also for other viral diseases as well as some protozoan diseases. The unit has been involved in vaccine development against BRSV infections. This research is very relevant to the control of viral diseases in livestock, and has evidently increased industry productivity as well as animal welfare. The recently started VTEC project is likely to have an impact on public health. The unit has healthy interactions with numerous of its stakeholders including public authorities, international bodies and industry.

Very high regional impact, but also global impact.
National and European

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The research focus of the unit has been targeted on viral and protozoan diseases and this continues to be their strength. While a new project has been started investigating risk factors for metabolic disease, this is not as innovative as their research related to infectious disease. The research interests of the group are centred around viral infections of cattle. While these infective diseases probably remain globally relevant, many of these are either not present (e.g. FMD) or no longer endemic in Sweden. Consequently, the group might have to broaden their panel of research topics in the future to achieve external funding and also to maintain the interest of the local industry. The recently employed professor has potential for this. The recent VTEC project is an example of a new research line. The unit seems however not to have a clear strategy for the future.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The group should develop a long term research strategy. Focus areas could be expanded both to apply funding from more sources and to be able to perform science-based teaching on a wider spectrum. The group would benefit from more intensive collaborations within the faculty e.g. with Animal Hygiene.

B 5. Additional information

See above.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 715_7 Small Animal Medicine

B 1. General assessment of the Unit of Assessment

The UoA is an extremely active group producing internationally recognized research of the highest quality. The group's research activities are clearly targeted at increasing the understanding of commonly encountered disorders in companion animals and applying this research to an enhanced understanding of similar disorders in man.

The UoA is well placed to exploit the unique opportunities offered by population studies based on naturally occurring companion animal models, especially when contextualised against the background of the limited variability of the canine genome.

The UoA has been particularly active in developing synergistic national and international collaborations which will allow it to be at the forefront of research developing the theme of "One Medicine".

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- This UoA has a clear direction and commitment to increasing understanding of disorders commonly encountered in small animals.
- Both Professors have high aspirations and are involved in research across two broad areas – genetic markers for various metabolic diseases and acquired heart disease in dogs and cats.
- Despite this breadth their research is of the highest quality with excellent bibliometric indices and in particular their work on mitral valve disease is recognized as innovative and with high impact making this group one of the world's leaders in companion animal cardiology.
- They have developed substantial collaborations both within SLU and Uppsala University, nationally and internationally.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

- The UoA is lead by two committed and dedicated Professors who have a clear understanding and commitment to insuring a synergistic balance between teaching (both undergraduate and post-graduate), clinical service and research.
- Professor Hedhammar has spear-headed the Swedish contribution to studying naturally occurring disease in a species with both limited genetic variability and a fully sequenced genome – the dog.
- Professor Häggström has been heavily involved in developing and delivering multicentre clinical trials and from this work has evolved a successful strategy of developing increasingly precise population biology studies.
- Professor Häggström's work has been seminal to, and intimately associated with, the most significant advances in the management of canine mitral valve disease in the last 20 years. The results of this work has had substantial international impact and changed the way the world thinks about managing this disease.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

- The UoA has an extremely strong track record in cardiovascular research. They are acknowledged internationally as a centre of excellence in this field, producing high impact studies that have advanced substantially the recognition and management of important companion animal diseases.
- These studies have been of particular importance and applicability to the veterinary pharmaceutical industry.
- The UoA is also developing synergistic collaborations which will allow them to be at the forefront of research targeted at utilising spontaneous naturally occurring diseases in companion animals and consequently developing the theme of "One Medicine".

The group is well placed to identify appropriate questions germane to both the canine and feline populations to which they have access, as well as identifying naturally occurring animal models for important human disorders. The impact of these actions is likely to be far reaching and of international significance.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

- There is a clear strategy of looking at common diseases – looking at diagnostics and developing quality and precision of diagnostics as well as concentrating on natural history of disease and their progression utilising evaluation of risk factors and also designing clinical trials and interpreting results of clinical trials. This area has huge potentials for collaborative

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

research across a broad range of biosciences.

- Desire to develop translational biology rather than translational medicine and there is real belief that SLU could be a unique centre of excellence because of the opportunities between veterinary science and animal science
- There has been a pleasing development of PhD students in the main areas of interest. However, the impression is that this may be challenged with the altered structure.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

not applicable

B 4. Actions for development at the Unit of Assessment

- The UoA must continue to develop synergistic collaborations which will allow it to be at the forefront of research targeted at utilising naturally occurring diseases in companion animals and consequently developing the theme of “One Medicine”.
- The unique opportunities offered by population studies based on naturally occurring companion animal models, especially when contextualised against the background of the limited variability of the canine genome.

B 5. Additional information

- There is a clear need for staffing levels to be clarified and stratified insuring the boundaries between clinical service work & rotational teaching are clearly established and not allowed to interfere with protected research time.
- For this to be achieved it seems likely that resources will need to be allocated to these duties such that the UAH pays pro-rata for the time academic spend in the hospital generating clinical income.
- Perhaps integration of the work of the department and the UAH could be considered along the lines similar to the association between SLU & SVA
- There is a need for expansion of activities in the region of Clinical Nutrition – a discipline that is sadly lacking at SLU and has particular reference if the strategy of developing the “One Medicine “ themes is to materialise.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 5. Animal Health

Unit of Assessment: 880_2 Animal Hygiene

B 1. General assessment of the Unit of Assessment

The UoA is located in Skara and belongs to the Department of Animal Environment and Health. Research is carried out on a number of questions arising from animal production. Three main areas can be recognized: a) animal welfare especially in relation to slaughter, b) interactions between dam and offspring and c) sustainable animal husbandry. The group has special expertise in bovine lameness and production diseases and studies the effects of the environment on these diseases. Research in general is applied research, making use of field data and accounting for the population. They have also conducted some experimental research with the methods, however, being more of standard nature than innovative. The UoA aims on increasing animal welfare and is active in promoting this in the public. It has created a network, is engaged in EU activities and collaborates within the faculty and with other research institutes in Sweden and in Denmark. The group has adequate facilities located in the middle of a very intensive farming area, which provides excellent opportunities to gather field data. They have very good relationship with industry and other interested parties.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Research is focused on important areas of animal hygiene concerning topics such as animal housing, management and welfare and hence the whole complex of animal production and health. Large scale epidemiological studies have been conducted to recognize risk factors for animal health. The group is developing methods for risk assessment of animal welfare and is internationally well recognized in this area. While this work is conducted by only few groups in the scientific community, other topics of the UoA are shared with more international groups. However, research in bovine lameness deserves to be mentioned as one of the strong focus areas of the group. Collaborative studies have been published, also related to endocrinological aspects of dam-offspring interaction, maternal behavior and ethical aspects of animal production. The leading member of the team has expert duties, e.g. as a member in EFSA panels. The papers produced in this context are not taken into account in the bibliographic analysis as these reports are not published as scientific articles. The publication record of the group is reasonable, but the journals selected as fora could partly be of a higher rank. Nevertheless the bibliographic analysis of the group shows a performance above

average for almost all indicators. The UoA has produced a good number of PhD degrees in 10 years. External funding is excellent.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The group is internationally highly recognized and has a leading position in some areas, e.g. research on risk assessment of animal welfare and bovine lameness. They have been able to create an enthusiastic atmosphere within their unit and have managed to attract PhD students. The unit has gained a status as a reputed group and has provided advice at governmental as well as European Union level. It is actively participating in debates on animal welfare and evidently does not hesitate to take actions to improve it. At the same time they have maintained good working relationships with industry and farmers. Group members have been awarded for their contribution to animal welfare.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group has been able to produce new data and hence new knowledge used in decision making processes concerning national legislation related to housing and management of farm animals. Results from their research have also been used in the European Union in preparing the new slaughter directive. The group has significantly contributed to EFSA reports related to housing of farm animals. The group has been active in providing results to be used in advisory services in Sweden as well as in other Scandinavian countries. The Swedish Board of Agriculture recognises this group as a trusted source of information in the field of animal husbandry. Finally, in their research the group strongly works for the benefit of animals and for sustainable animal husbandry. They have been successful in making contracts with industry to support their research.

Nordic and European, long-term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The first and evidently most important goal is to develop the methodology for risk assessment of animal welfare to a nationally and internationally approved level; this clearly falls into the competence of the group and sounds relevant and realistic. The strategic plan then continues

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

with a variety of projects and could in general be more focused. Some of the envisaged goals, however, may be beyond the scope of the UoA. Potential research partners are not specified but only given at a general level. The group would benefit from a more international collaboration. Working collaboration with other groups on the main campus needs continuous attention, due to the distance between sites.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA should focus on its areas of competence. More collaboration with international research partners would be advantageous.

B 5. Additional information

The academic staff of the UoA is relatively small; in relation to the number of professorial positions the number of “middle” academic staff should be increased. This unit is of high societal value because of its integrated approach to animal welfare and production.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 6. Animal Husbandry

Please note: This Panel followed the SLU guidelines and evaluated only the publications presented to us.

1. Content and Strength of the Research Field

The Research Field is very broad covering species as diverse as reindeer and fish and disciplines as different as genetics and animal behaviour. It also covers the key food products relevant to Sweden although there is an overwhelming emphasis on ruminants. It was also clear that the quality of science being carried out in the Field is rather variable, in part because activity ranged from research to extension. The breadth and diversity of the work in the Field is a major strength although crucially, it is believed that this strength is not currently being fully exploited and that changes in the way that research is organised will be needed for this to happen.

In addition there are areas of current work which are borderline or worse in terms of being able to undertake hypothesis-driven research capable of producing measurable science outputs. One of these in particular (The Reindeer Unit) is much closer to being a component of extension than a research unit. SLU will need to make difficult decisions about the future of these parts if the key objective is to increase the quality of research.

2. Future Potential

The Panel supports the large investment in new facilities and believe because of this and the breadth of expertise that the future potential is large. However, the work needs to be focused and co-ordinated to answer the key questions facing modern food production in the EU and in Sweden in particular. Education of industry as to the benefits of longer term, more in depth research may be a useful avenue.

3. Synergies, multi- and inter-disciplinary activities and strategic coordination between the UoA

There are clearly enormous synergies between various UoA in the Field. However many of these appeared to the Panel as overlaps of activity which were not integrated. Examples of this include the work on ruminant nutrition/feed characterisation which was evident in Animal Husbandry, Ruminant Nutrition, Ruminant Management, Feed Science and Production Systems and the work on behaviour in the Ruminant Management, Poultry and Ethology UoA. With one exception, evidence from authorship of publications indicated very limited collaboration. Whilst aspects of this clearly were the result of geographical location it is believed that better management/integration of activities would provide benefits and reduce certain 'overhead' resource use. It is believed there is good scope for environmental monitoring activity.

4. Infrastructure that facilitates world class research

It is believed that the physical infrastructure required is well catered for given the current investment in new animal facilities, although there is concern as to how the cost of this

investment will be translated into costs of research. The organisational infrastructure however needs attention and in particular the following questions will need to be answered:

- a. What is the SLU research mission?
- b. Should some current UoA be re-classified, not considered as research units and evaluated differently?
- c. How can current UoA be organised to best deal with a) above?

If work in developing countries is to continue it needs to be much better co-ordinated and managed than at present.

5. Important research areas missing

There was little evidence of detailed work on pig and poultry nutrition and this should be increased. There was no indication at all of any exploitation of the new 'omics' techniques including nutrigenomics. Apart from the understanding of processes that these could give, the work would be publishable in very high impact journals. Also there seemed little attention paid to the composition and nutritive value of animal-derived foods (with the possible exception of fish). There was some evidence in some UoA of an interaction with Food Science in SLU but again a closer integration in the future would seem essential.

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 251_2 Aquaculture

B 1. General assessment of the Unit of Assessment

The mission of the UoA is to contribute to the improvement of knowledge in fish farming as well as to the development of this sector in Sweden. Based on the self-assessment report, the UoA is rather small as it includes eight persons (but only 5.6 FTE). However, the UoA is collaborating intensively with some other departments belonging to different faculties (Department of Food Science, Department of Biomedical Sciences and Veterinary Public Health). According to the main publications of the UoA, the research activities focus on genetics and breeding programme of Arctic charr, fish behaviour and welfare in aquaculture conditions, diversification of freshwater fish culture, interactions between fish culture and the environment, and fish nutrition (lipid and fatty acid metabolism). However, the panel had many difficulties to clearly distinguish between the activities conducted by the UoA itself and those conducted in aquaculture within SLU, but not directly under the supervision of the UoA. In this regard, an important research area on lipid nutrition in fish is developed under the responsibility of one senior scientist belonging to the Department of Food Science, but collaborating with the Aquaculture UoA. One professor is sharing his research activities between SLU (20%) and the Life Science University of Ås in Norway (80%) but the panel cannot distinguish where the research is actually done.

The efforts invested in the improvement of Arctic charr genetics seem to provide some substantial return for the UoA as very significant support from both SLU and the Ministry of Agriculture has been allocated recently for creating a large aquaculture facility for the production of genetically improved Arctic charr as well as for the recruitment of two post-doc positions. The nutrition studies have also shown significant results in the evaluation of plant oils in aquaculture feed. Impaired by low public and private funding in the sector during the last decades, the aquaculture R&D in Sweden seems now entering into a more favourable period and should allow the UoA to increase its research activities and scientific production in the near future.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA has been among the pioneer groups investigating the fish behaviour and welfare in the aquaculture context, with the development of innovative techniques using PIT-tags to monitor individual fish behaviour within a group. This research axis has allowed the publication of a significant numbers of papers in highly ranked journals. Research on fish nutrition has produced high quality publications during the recent years. Several papers of good to very good quality have been also published in relation to the diversification of Swedish freshwater aquaculture through perch farming. The research includes an appropriate

balance between basic and applied research.

Based on bibliometric indicators, the UoA can be ranked among the good groups of the Animal Husbandry panel. However, as reported in B1, and after the interview of the UoA, the panel has some difficulties to determine which part of the scientific production is really related to the research done by the Aquaculture UoA and which part is related to other groups (Department of Food Science, Life Science University in Norway) for which the contribution of the UoA is low or inexistent.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has a very good recognition within the aquaculture and aquatic ecology research fields. The group is involved, as coordinator or partner, in international collaboration programmes, including European projects and network (chairman of a COST network on Fish Welfare in Aquaculture). The scientists are recognized by the national authorities as experts in their field and have been invited to elaborate an action plan for the development of the aquaculture sector in Sweden. With regard to leadership, the attractiveness of the UoA should be improved as the number of PhD students has been relatively low during the last decade, with only one thesis defended from 2004 and one foreseen in the coming months. Expected increase of funding and human resources, with the recruitment of new post-docs, should improve the situation in a near future.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA contributes to the development of aquaculture in Sweden, through a programme on fish genetics and breeding (Arctic charr) and species diversification (Eurasian perch). A national action plan has been produced by the UoA at the demand of the Swedish government, identifying the strategy and priorities in terms of investment, research, marketing, environmental issues, etc. Although the Swedish aquaculture sector is rather weak, compared with other European countries, the UoA is collaborating well with the existing fish farms, as well as with the Swedish Board of Fisheries.

Research activities of the UoA are both related to general problem of aquaculture, with medium to long term perspectives (for example on fish welfare in aquaculture or replacement of fish oil by plant oil) as well as to Swedish aquaculture development (aquaculture of niche market species such as Arctic charr and Eurasian perch).

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

Eight research priorities have been identified for the future development of the unit, including both basic and applied research, with local and international expected impact. The UoA has also elaborated a strategic research plan for sustainable fish farming in Sweden and the way the Aquaculture Group of SLU (8 researchers from 3 faculties) could be involved in this development. Thanks to the support from SLU, Swedish government and industry, the potential to get more funds and to increase the human resources in aquaculture research seems now present, but the way the UoA will manage this opportunity is still unclear. The strategy and potential described in the self assessment report largely exceeds the capacities actually existing in the UoA but include many aspects that are or will be under the responsibility of researchers not presently belonging to the UoA. It would have been clearer for the panel to see what exactly the strategy of the UoA is, and how a part of this strategy will be achieved through collaboration with other departments. The position occupied by one professor will be vacant within the next two years. The activities of the UoA will also depend on how this position will be renewed in the future.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

Potential for improving the productivity of the UoA and for developing high quality international research in aquaculture is present in SLU, but the present organization is such that the research is conducted in several departments without clear collaborations between groups. The panel is recommending to better structure the research and development activities of SLU in the field of aquaculture by creating a centre of excellence including the present UoA and the other researchers already involved in aquaculture but presently depending on other departments and faculties. This centre should have strong academic leadership. Although some occasional collaboration already exists between these researchers, this new structure would allow a significant increase of the critical mass without physical movement of staff and a better coordination of the research priorities identified by the UoA. The profile of the new professor supposedly to be hired within the next two years, in replacement of L.O Eriksson, should be defined in respect with this future structure.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 540_1 Animal Husbandry

B 1. General assessment of the Unit of Assessment

There is a very large difference between the facilities and the research carried out in the past compared with the current facilities and the plans and prospects of future research. Research in the past can be characterized as applied in the area of forage utilization primarily by dairy cows, without intention to physiologically or mechanistically explain the results. Results were primarily of regional value. Both by the building of a new research facility and the appointment of a world level scientist in the field promises a very good level of applied-basic research by the Umeå group studying the relation between composition and feeding value for forage grown at high latitudes and integrated plant-animal approaches.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research group carried out applied research in the area of forage utilization by dairy cows and sheep. The intention of the group also was also to look into the relationship between intakes and product quality but the publication record does not show that. The bibliometrical analysis pictures the UoA as below SLU-average. For some parameters the value is average, due to input which seems not to be primarily the achievement of the UoA but by collaboration.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has a regional role with respect to forage utilization by dairy cows. It has been initiator of a platform of collaboration (Forage Research Center) and also involved in the Nordic Forage Network.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The UoA's research theme contributes to sustainable agriculture by its focus on the utilization of locally produced feeds. In particular strategies of mixed feeds like whole crop pea-oat silage and grass-clover silage contribute to the body of knowledge which benefits industry and by that society as a whole. In future the contribution is expected to be even higher due to an increased degree to which research findings can be generalized above the level of specific experiments. The intention to set up mechanistic models explaining intake and output will contribute to that.

As yet there does not seem to be any intentions to contribute to the adaptation of animal production to climate change as this affects forage properties, but the UoA seems well equipped to do so.

The UoA's contribution in the future will expand above the regional level and will be of a more general value for high latitude regions globally.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future strategy is built upon the arrival of the newly appointed professor and is characterized by the UoA's ability to carry out applied-basic research. This is research with relevance for application simultaneously contributing to the body of understanding mechanisms explaining relationships in integrated plant-animal systems. One of the means to contribute to this is the development of mechanistic models and the intention to study nutrient cycles. An important element in the strategy is to fully utilize the new research facility by attracting external funding for post-docs and PhD's and set up collaborations with for example Jokioinen and Cornell.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable.

B 4. Actions for development at the Unit of Assessment

As pointed out in relation to B1 (characterization) and B4 (strategy and potential) the future of the UoA is strengthened by the building of the new research facility and the appointment of a new professor. It is obvious that capitalizing on these depends on sufficient funding. At the same time the dependency, certainly on the short term, upon the qualities of one single person should not be underestimated.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 650_1 Monogastric Animals, Nutrition

B 1. General assessment of the Unit of Assessment

The scientific interest of the UoA is spread over a wide scope of nutritional aspects. The present work is focused on pigs and horses and to some extent on small scale poultry. There are plans to extend the activities towards fish and companion animals. The field of scientific interest is extremely wide. It not only comprises a large number of conventional and unconventional feedstuffs (silage, local forage, chickory, fermented cereals) and nutrients (NSP, minerals, pro-biotic bacteria) but also toxic substances (mycotoxins). Tables on the nutrient requirement of horses and relevant nutrient contents of feedstuffs are being published online. The UoA intends to study nutritional and anti-nutritional effects not only on the “whole animal”, but also at the cellular level. Besides performance, such as growth, lactation and physical exercise, the research also comprises special criteria such as the fluid balance in horses. Studies are carried out under conventional intensive management systems as well as extensive organic production. Problems of animal nutrition in developing countries in South-East Asia and Africa are considered as a main focus of the UoA.

Considering the width and depth of the nutritional aspects, the variation of production systems and geographical scope of the ongoing and planned activities of the UoA, it is not possible to identify a clear strategy. Nevertheless the UoA has placed a reasonable number of articles in renowned journals. The bibliometric profile is balanced on an intermediate level (5). Although the UoA comprises two professors, two lecturers, seven senior and one junior researcher and 13 PhD students this does provide the breadth of expertise needed to cover all the proposed aspects of monogastric research. There is some overlap with the UoA Feed Science with regard to silage feeding to horses.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The bibliometric performance of the UoA is satisfactory. However, the UoA has been working on generally well known issues using established methods. The level of originality and the choice of methods cannot be considered as extraordinary and innovative. This applies to the studies on mycotoxins as well as fibre and fermented grain. The use of cannulated pigs is widespread in animal nutrition. The use of cannulated horses, however, can be considered as unique aspect of the UoA.

Considering the wide range of interests spread over a wide geographical region, the evaluation panel was not in a position to identify a clear research strategy. Despite common

interest in closely related areas of research there is obviously little cooperation with other research teams (e.g. Feed Science).

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Due to their engagement in developing countries they are known to research institutes and the ministries concerned in selected Asian and African countries. They also have good contacts with developing agencies. The number of PhD students shows that the UoA provides an attractive environment. This is expressed by the number of PhD students from Asia and Africa. The scientists of the group in their self-evaluation mention problems to be acknowledged by the farmers and the livestock industry in Sweden. The recognition and leadership in their field of activity and in the Swedish society seems to be not as high as in the developing countries.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

With regard to the activities of the UoA in developing countries they follow extremely complex traditional production systems in rural areas, e.g. small scale animal production in combination with crop production, fish ponds and biogas digesters. Although these systems are known for a long time and have been studied extensively, it has proved to be extremely difficult to improve them or to transfer them from one region to another. It is doubted that, with the special knowledge in animal nutrition, the UoA will succeed in this field so as to improve the living conditions of the farmers concerned.

Because of the low level of acceptance by commercial pig producers in Sweden, the contribution of the UoA to the development of the society is not considered essential. There is some scope for improvement of the conditions of athletic horses provided the the new feeding strategies (use of silage) is successful.

The objective of the engagement of the UoA in developing countries is the improvement of the living condition through improved livestock production in some South-East Asian and African countries. Knowing the problems of implementing improved techniques in this field, there is no scope for short-term and intermediate-term activities. Considering that the members of the UoA do have duties at the SLU which prevent long term absence and considering further the short term character of most projects, the prospect to achieve long term results are doubted.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The number and qualifications of the staff present a good basis for successful research in monogastric feeding. This is underlined by high quality publications in selected fields. There is however an urgent need for a concise research concept which is adapted to the available staff resources. Considering the limitation in time and staff of the UoA the evaluation panel expresses its concern on the efficiency and quality of research in so many different countries and on the planned engagement in the field of aquaculture systems in Asian countries. The gender ratio is reasonably balanced with a slightly higher number of women.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

There is no FOMA activity

B 4. Actions for development at the Unit of Assessment

Basic research on monogastric nutrition is a vital element in SLU's livestock research programme. The UoA should focus their scientific activities and resources on relevant nutritional problems in pigs and horses. It is also recommended to that poultry nutrition is added to their remit. The nutritional support of monogastric animal production should be given a higher priority than the work in tropical countries.

In order to strengthen the research activities in developing countries it is recommended that the UoA coordinates its work with groups of SLU and other researchers abroad working on the same subjects. On the basis of a larger group it may be possible to draft project proposals with larger scope covering longer periods. Using the complementary effects of different research groups (including possibly economic and social aspects of development) the project will have a higher potential to achieve substantial improvements and attract funds from important donors. The need for cooperation with other working groups applies also to the research in horse and pig nutrition in Sweden.

B 5. Additional information

There are many UoAs at SLU which are engaged in research activities in developing countries. These activities not only increase the visibility of SLU but also attract scientists and PhD students from other continents. It is recommended that SLU coordinates the scattered activities.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 650_2 Ruminants, Nutrition

B 1. General assessment of the Unit of Assessment

Current research is focused on the nutritional and animal health aspects of forages with some emphasis on organic production, the environmental impact of ruminant animal agriculture (methane, N, P losses to the environment), evaluation of by-product feeds with emphasis on those from biofuel production and various aspects of animal nutrition in low income countries (e.g. Vietnam, Laos). Although the work has very much focused on the needs of Sweden and the low income countries, the broad research topics are highly relevant to current world issues of food security, food production with minimal environmental impact and utilization of cellulose-based feed resources. There is however no research related to food composition/bioactivity. The UoA is small with only 3.8 FTE of staff (excluding PhD students and animal technicians) but there is good evidence of collaboration with scientists in Canada and the US though little apparent collaboration within the EU. The small size of the UoA together with teaching commitments etc. will limit the depth of research achievable and the career development of the scientists. There is clearly overlap of activity with 650_3 (Ruminants, Management) and 650_5 (Feed Science) both of which are also small and there may be merit in considering combining them into one unit to provide a more integrated approach with adequate critical mass. There is also overlap with 540_1 (Animal Husbandry) in terms of work on forages. However, based on publications data there is good evidence that the Ruminant Nutrition UoA, almost uniquely, is driving the current interaction with the other Units.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research ideas identified are quite focused on issues that are widely recognized as important. The methods used to research the problems seem entirely appropriate and commendably, there has been collaboration with researchers in Canada on techniques for area monitoring of methane production by ruminants. Research on reducing P loss to the environment has also been undertaken via a collaborative programme with Penn State University. Some aspects of the research appear to be novel and challenge long held nutritional beliefs. In particular the findings that dietary K has little effect on Mg status of lactating dairy cows will require text books to be revised and will fundamentally change the advice given to farmers. Also the work on P metabolism in dairy cows has provided new data on P requirements but critically included makers of bone mineralization/demineralization. The work will allow diets to be formulated with lower P contents leading to less environmental impact.

The geographical scope of the work is quite focused on Sweden and the low income countries in the Far East. The productivity of the UoA in terms of scientific publications appears very high considering the small number of staff involved. Fifty-five scientific papers (14.5/science FTE) have been published together with a good output of conference proceedings over the recorded period. In addition 17 PhD theses have been produced in the last 10 years. There is good evidence that collaboration with other UoA is being driven by this Unit.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The scientists involved are clearly very knowledgeable in their field of expertise and there is evidence of two of them have are involved as experts on for e.g. greenhouse gas mitigation and for research application assessment in a non-Swedish University. The UoA has however had very few invitations to speak at international scientific conferences which may suggest that members of staff are not recognised as leaders of the scientific debate in the area.

Overall the research environment is attractive though as mentioned earlier, the UoA is probably too small to provide good opportunities for research careers.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

A key element of future strategy is to focus on issues/problems associated with environmental emissions from dairy cows, work on home-grown protein resources and further work on the metabolic issues of the periparturient cow. Given that Swedish milk production is likely to considerably intensify and that there is a high interest at both science and public levels in environmental impacts, the potential to the industry and society should be high.

Sweden is the main focus of much of its work although there is some work in developing countries. The new dairy cow facilities should provide a long term perspective and allow more detailed in depth studies.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy goals given by the UoA are sound but it is not really clear how they can be achieved without an increase in staff numbers. Interestingly one of the stated aims is to

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

'strengthen collaboration with Feed Science and Ruminant Management Groups'. It may be that this should be more than collaboration but in any case some action here seems essential. The research direction identified looks largely more of what is currently being done. This is not really a problem as what is being done addresses some key topics though there needs to be ambition to research these at a more fundamental level and the new facilities should allow this possibility. Some consideration of effects of animal nutrition on dairy food nutritive value/bioactivity may be appropriate.

The overall gender balance appears satisfactory (51% female) although there is a need for new junior scientists to further develop strategy.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

It is not clear how having two research activities so far apart geographically (i.e. in Sweden and the Far East) affects the efficiency of the research process. With such a small UoA such an effect could be large and negative. This strategy should be reviewed. International links within the EU should be enhanced considerably probably best via more involvement in the EU Framework research programme. Consideration is also needed as to how it can achieve the critical mass needed for creative research development. Enlargement of the UoA seems essential and integration in some way /collaboration with Feed Science, Ruminant Management and Animal Husbandry would appear to be options.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 650_3 Ruminants, Management

B 1. General assessment of the Unit of Assessment

The research is very much focused on the dairy cow with research on topics including many aspects of automatic milking, effects of milking techniques on milk quality and udder health, sustainable lactations, summer heat stress in cows in Sweden, work in India connected with the Water Buffalo and work in developing countries. There appeared to be a good mix of older and younger researchers and PhD students. Some of the work has been done in collaboration with the ruminant nutrition UoA and other Departments at SLU although this could be increased. The topics studied and their breadth and content seem very sound and the depth seems generally appropriate though despite cow/lactation physiology being identified as a 'niche' for the UoA there are very few scientific papers published in physiology journals of high merit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

A lot of effort has been put into the topics related to automated milking and it was not too clear how applicable this technology is to dairy farms in Sweden or to what extent the availability of the machinery had dictated the research direction. It is accepted that the facilities can be used as a model for examining dairy cow behaviour etc. Based on the topics researched and on the range of papers published the overall quality of the research appears good. Some of the work on extending the work on dairy cow mastitis to humans appears quite novel though how reliable the cow model is to humans was not developed. The UoA seems to have been successful in developing a reasonable network of collaborators notably within SLU and in Denmark. Such collaboration is essential for successful research activity. Despite the stated aim little detailed lactational physiology was apparent although it is accepted that they have recently brought in a visiting/part-time member of staff with expertise in this area.

The geographical scope of the work is quite focused on Sweden, India and some other developing countries. The productivity of the UoA in terms of scientific publications appears reasonable though not high considering the size of the UoA. Forty-one scientific papers (5.5/science FTE) have been published together with a good and fairly consistent output of conference proceedings over the recorded period. A total of nine PhD dissertations were published.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The scientists involved are clearly very knowledgeable in their field of expertise but there is little evidence of them having been involved as experts on assignments outside of Sweden. The UoA has however had invitations to speak at international scientific conferences indicating some international recognition though this has not been at a high level..

Overall the research environment appears to be attractive and the new facilities being created should add to this although some more formal links with related UoA may be helpful to create a more integrated research environment.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

A key element of future strategy is to focus on issues/problems associated with large dairy herds. Given that Swedish dairy herd size is increasing and that there is a high interest in approaches to automated milking the potential to the industry should be high. Society has an interest in the welfare of food producing animals and the UoA can make an input into this too.

The UoA accepts that Sweden is the main focus of its work although there is an element related to developing countries. The new facilities should provide a long term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The concept of creating an international centre of excellence in farm animal lactation is an exciting and worthwhile prospect and the areas of research planned seem sound including the whole system approach and aspects of cow traffic management. Some in-depth activity on lactation physiology seems essential. The desire for increased international collaboration within the EU and the Nordic countries is also important. The plan to develop this by maintaining a creative mix of senior and younger researchers/PhD students is also commendable. There is definitely some overlap between the work of this UoA and Ruminant Nutrition and Ethology/Behaviour (and probably Feed Science) Units and there is a definite need to exploit this better which may also reduce the mentioned competition between SLU scientists. There are other concerns about the future strategy. There seems to have been conflicts between research and teaching/administration commitments such that research activity has been curtailed. This needs resolving if future research is not impaired. This is particularly important given the large investment SLU has made in new dairy cow facilities. The way in which the costs associated with such new facilities is charged to research grants also needs careful consideration so as to avoid research facilities becoming uncompetitive

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

with those in other institutes. The gender balance seems satisfactory with 54% of FTE being female.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA is involved in a FOMA project concerning the interaction between the grazing animal and the biodiversity of semi-natural pastures although the work belongs to another part of SLU. The project is relatively young but some early data related to nutrient transport between areas of low and high biodiversity look interesting. Future strategy in this project looks sound though it is clear that for such long term projects to provide benefits, long term sustained funding is necessary.

B 4. Actions for development at the Unit of Assessment

There do appear to be some conflicts which require attention. It is not clear how having two research activities so far apart geographically (i.e. in Sweden and India and elsewhere) affects the efficiency of the research process, particularly when there also appears to be conflicts between time available for research/admin. and teaching. There does seem to be some overlap of activity with Ruminant Nutrition, Ethology/Behaviour (and maybe Feed Science) Units and some integration may provide a bigger more flexible unit. Further international links within the EU should be created with some urgency probably via more involvement in the EU Framework research programme.

B 5. Additional information

As mentioned above the way in which the costs associated with the new facilities are charged to research grants needs careful consideration to avoid being uncompetitive. This could affect several of the current UoA.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 650_4 Poultry Nutrition and Management

B 1. General assessment of the Unit of Assessment

The work of the UoA is problem-oriented and focuses on aspects of housing and nutrition of laying hens and broilers. The most prominent issues at the time of the report were stepwise improvement of furnished cages for laying hens. It has to be mentioned in this context that the UoA was the leading institute which brought the furnished cages as an alternative system to conventional cages from the experimental stage to commercial use in Europe. Further improvements of details in the cage design (nest linings, perch design, claw abrasives) are sought by systematic comparisons of different variants using performance, egg shell quality, feather and foot conditions and behavioural criteria. The scoring systems for feather cover and foot conditions of laying hens, which has been developed by the UoA has been widely adopted by the leading European research groups working on housing and welfare of laying hens.

The nutritional aspect of the UoA was focused on the effect of fibre on performance and gut health in both, layers and broilers.

The UoA is carrying out experiments with organic broiler production with special reference to nutrition. The constraints, especially with regard to essential amino acid supply, have lead to the idea to harvest mussels which have been imported from the Black Sea to the Baltic Sea for the production of poultry feed.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific work in the development of housing systems for laying hens as well as the experimental work in poultry nutrition can be characterised as typical R&D activities. They are clearly problem-oriented and attempt to find a solution through systematic variation of relevant factors. On this level the UoA strictly follows scientific principles. While the main competence of the UoA is nutrition and management, more specialised studies on physiology (e.g. stress) or internal egg quality is carried out in cooperation with other scientists within or outside SLU. This cooperation needs still to be developed.

The publication activity is adequate relative to the small number in the working group.

The geographical scope of research in layer housing is based on the EU Directive on the keeping of laying hens. The results are therefore important for other European countries and countries outside Europe which may follow the European poultry welfare standards. The international interest in this matter is reflected in the numerous invited papers in international meetings. The poultry feeding activities are linked to particular problems arising on the national level.

The declining publication productivity within the period is explained by the accumulation of negative factors, such as the leaving of one senior scientist whose publications represented the essential work in broiler research but which are not included in the list of publications, maternity leave of scientists, planning of new poultry research facilities and administrative obligations of the head of the UoA at the department and faculty level.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The recognition and leadership is outstanding with regard to the development of furnished cages. Most of the international activities, such as international cooperation (participation in EU projects, e.g. EGGDEFENCE, LAYWEL, invitations as invited speakers to international congresses and symposia) are related with this subject. The leading researchers are generally recognized in international scientific organisations (WPSA) and in EU expert panels.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The main research areas of the UoA respond to the requirement of the northern European population of improving the welfare of laying hens and broilers, the supply of healthy food and the increase of the production of organic food. The working conditions of the poultry keepers have also been considered. The research results provide important information to the manufacturers of commercial poultry housing systems and equipment.

The scientific results of the UoA on the development of furnished cages have been essential for the replacement of conventional cages on the EU level. The results have also raised the interest of authorities and research institutes in the US and in Australia.

The implementation of the results in the commercial sector occurred within a time span of about 5 to 10 years (intermediate-term). The introduction of this housing system in a wider geographical scope (eastern Europe, America, Australia) is considered a long-term project. The impact of the nutritional and managemental factors in broiler production is of local interest. It is expected to influence commercial poultry meat within short-term. The idea of developing mussel production for poultry feed may be implemented in intermediate-term.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

On the basis of the established experience the UoA will continue to further develop management systems for laying hens and feeding strategies for both, layers and broilers and thus, influence the development of management and feeding of layers and broilers on the national and international level. The UoA will soon have new experimental facilities for layers and broilers. They will provide more flexibility in the arrangement of experimental compartments and better working conditions for the staff. The new administrative system (the facilities and technical staff are in the responsibility of the department) will open the access to the experimental capacity to a wider spectrum of users and alleviating administrative work pressure of the scientific staff of the UoA. The spared time can be used to increase the number of publications. The new facility provides facilities for small units for basic physiological, ethological and veterinary studies. Such studies are essential complements of the applied research approach of the UoA.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

The evaluation panel strongly recommend the cooperation with research groups working on basic research of poultry physiology, ethology and veterinary problems. The synergic effect of such cooperation will not only improve the utilisation of the new research facilities, but also the quality of the publications. Since nutrition is a vital element in broiler and egg production systems the support from the Monogastric Nutrition group has to be sought.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 650_5 Feed Science

B 1. General assessment of the Unit of Assessment

The work in this UoA seems to be to a large degree concerned with aspects of forage conservation as well as some work on feed characterization for ruminants and equines though ruminants appear to have greater coverage. The research undertaken is quite broadly based and the conservation work in particular is heavily influenced by the funders of the work. No doubt this stimulates rapid take up by the industry. The feed characterisation area is involved with the development of *in vitro* methodology to simulate microbial degradation processes in the rumen and host enzyme digestion. There does appear to be some novel aspects to this including mid-infrared spectroscopy (MIR). Few places have expertise in *in vitro* simulation of digestion in horses and the work in collaboration with the National Stud of Sweden is likely to be valued. Some work has also been undertaken in Vietnam. Overall, there is concern that the science quality of the UoA is being diluted by work which no doubt has high value to the funders, but does not lead to scientific publications.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The Panel had some difficulties in assessing the Unit as a whole because of the differences between the dominant area of forage conservation which is very applied and customer focused and the more research oriented feed characterization. The forage conservation area is largely done in connection with commercial funding sources and whilst it may have high uptake does not produce many scientific papers to demonstrate science quality. There was evidence of novelty in feed characterization including aspects of digestion dynamics which are difficult to simulate, the use of MIR, and the integration of laboratory data with mechanistic models of digestion, absorption etc. The key problems these would be used to solve seemed a bit general. There was some evidence of collaboration within and without SLU although this area could be enhanced considerably.

The productivity of the UoA in terms of scientific publications appears low for the size of the UoA with 26 scientific papers (4.5/science FTE) published over the recorded period along with only one PhD thesis. Citation of publications was also not high. It is felt that the publication data and science quality in general have been considerably diluted by the large amount of conservation related work which does not generate measurable outputs.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The scientists involved are very knowledgeable in their field of expertise and there is evidence of some staff having been involved as experts on assignments although almost all were within the Nordic countries. A notable exception to the latter point is Prof. Udén who holds a senior editorial position on a widely respected international journal. The UoA has however had relatively few invitations to speak at international scientific conferences although interaction with industry within Sweden has been high and has led to grants awarded.

The research environment appears to have good laboratory facilities but greater integration with other aspects of animal nutrition work at SLU would enhance this as may increase the attractiveness to PhD students etc.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Based on historical evidence there is good interaction with industry and continued funding from industry appears to be highly likely. This will no doubt generate new knowledge relevant to industry in particular.

The geographical scope of the work is quite focused on Sweden with some work in Vietnam. Much of the forage conservation-type work is short-term. This will limit its value in relation to a long term research strategy and will limit its attractiveness to new researchers.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The overall strategy of carrying out more longer-term and deeper studies should be encouraged although it is believed that some changes will be needed to allow this to happen (see Section B4). Some of the stated future methodologies were interesting although the key questions these would address were unclear. Quite a bit of emphasis was placed on future work on equine feeds although this may be of less strategic importance than food producing species.

The UoA expressed some concern that when the new animal facilities are complete there will be physical separation of animals/animal staff and scientists/laboratory staff. Such apparently small issues can cause major problems and the management of this issue needs thought.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

The UoA has good research links with other institutes and departments and has a good track record of securing research grants. Its work plays an important part in the overall process of converting feeds into human food (and horses for sporting/pleasure activities). However the size of the UoA is not large and there does seem to be some overlap of activity with Ruminant Nutrition, Ruminant Management, Production Systems and Animal Husbandry and some integration needs to be considered. There may be a case for creating a core Feed Science group which interacts with the research of all species. Focusing this would generate a critical mass of expertise where the various species interests could interact. A decision is needed by SLU as to whether the more applied/commercial work fits with its overall objectives. If it does then it will need to be evaluated differently from the research work.

Overall, more collaboration within the EU is very desirable possibly via more involvement in the EU Framework research programme and programmes which support PhD students.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 670_2 Quantitative Genetics and Animal Breeding

B 1. General assessment of the Unit of Assessment

The research of the UoA is characterized by a focus on the genetic aspects of functional traits in a variety of farm and companion animals, rather than an interest in solely production traits. In that way the UoA wishes to address the genetic change in the direction of higher productivity which goes hand in hand with good health and welfare of animals. The UoA belongs to the Department of Animal Breeding and Genetics together with UoA 670_1, Molecular Genetics and Bioinformatics.

The UoA has an interesting niche because of the strong connection with industry and by that the availability of systems where a broad array of traits are recorded. The UoA successfully harvests on this. The UoA can be characterized as an early adapter in that new (statistical) methods are used in an early phase. The list of publications shows a broad spectrum of subjects including high standard quantitative genetic analysis of functional traits and the analysis of physiological traits e.g. related to boar taint and fertility traits. The list shows little interaction with the other UoA in the Department. The bibliometrical analysis shows that the group publishes in high rating journals well appreciated by colleagues in the field. The group ranks clearly among the upper third of SLU.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

To meet its focus, the UoA uses up to date analytical methods. With respect to statistical analysis the group can be seen as an early adapter, e.g. in the use of Gibbs sampling, survival analysis and random regression. The group is original in the choice of these methods for the scientific questions which fit the remit of the group. On the SLU-scale the productivity of the group per PhD is average but the group clearly scores above average for other parameters like the quality of journals and citations. This illustrates that the group is well recognized in the international scientific community. There is a very good presence of members of the group in international conferences, where they are recognized as very good presenters.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

On the basis of the focus on functional traits the group plays a prominent role in the scientific debate on the genetic evaluation of farm animals. This is even more so due to the fact that the Department provides the home base for two internationally operating groups in the area of breeding value estimation, Interbull and Interstallion. The group has an open atmosphere and apart from the availability of field data good experimental facilities. There is a clear ambition to educate a large number of PhD students. These are well supervised and find their way in various universities and industry. The view of the UoA on genetic change of farm and companion animals is well recognised in society.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The focus on functional traits and the up-to-date science with respect to genetic improvement of animals gives the group profile which contributes to the scientific world but clearly supports industry. This is enhanced by the good relationship the group has with industry. This is not to say that industry will follow the views of the UoA without critique due to the competitive world the industry is living in. It provides the industry ample insight and understanding to choose its direction. The group contributes to the sustainable development of society and the position of animal genetic improvement in it, in particular by the clear interest in the broader perspective.

There is a strong and long standing cooperation of the UoA with other Nordic countries which also is illustrated by inter-Nordic teaching of PhD students. Similarly, the UoA is active in Europe in that respect. It illustrates the long term presence of the group in the animal breeding arena. The group is present on all geographical scales due to its interest in research issues in both developed and developing countries and due to its connection with Interbull and Interstallion.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The group has a good future but the Panel has the strong conviction that a far stronger interaction is required with the molecular geneticists in SLU to further develop its potential. The research interests currently seem to deviate, which is most clearly illustrated by the nearly complete separation of the publication lists of 670_1 and 670_2. The group has an open mind to recruit new (international) staff and is aware of the need to develop more strength itself or by collaboration in the field of biostatistics. The gender balance is strongly skewed. By far most PhD's are female.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

The Panel feels that the focus of the UoA is appropriate. With its focus on functional traits it has a relatively unique position in the scientific arena and the UoA should perhaps exploit this even more than it does. The Panel feels that a far stronger capability of the UoA is required in the area of molecular genetics, which may or may not be achieved by collaboration between the two groups in the Department of Animal Breeding and Genetics (assessed as UoA 670_1 and 670_2). The further development of strengths in the area of biostatistics, either by training, recruitment or collaboration, is required to fully utilize this stronger capability.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 880_1 Ethology and Animal Welfare

B 1. General assessment of the Unit of Assessment

The research of the unit is concerned with the behaviour and welfare of farm, companion, fur, laboratory and zoo animals as well as animals kept in nature reserves. From the past decade the orientation has made a major shift from entire ethology towards applied welfare research with a strong move to welfare assessment and policy implementation. This is reflected in recent publications deriving from international collaborative projects, mainly on EU level. The most recent creation of a professorship in ethology in collaboration with the existing professor in animal welfare has strengthened this effort. Research on injurious behaviour, mother-young interactions, social behaviour and behavioural adaptations to different housing environments and enrichment has been expanded from the past. The efforts on basic research such as animal cognition, motivation and emotions should be strengthened. Multi- and interdisciplinary activities are obvious for all levels (local, regional and international). The UoA has gained a status of very high competence with regard to content, depth and breadth in their field belonging to the top ranked groups within the department and faculty.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific quality of publications has reached in part a very high international standard having papers placed in high ranking journals such as Nature and Animal Behaviour. The group should expand on their efforts to create original ideas and new methodologies. They have to find the right balance between applied and basic research. The NCSf of 1.45 and scaled hf-Index/PhD of 3.95 is well above the average. The group seems to depend in part on import for specific expertise. Collaboration with other units such as neurobiology and physiology is necessary as their targeted research approach is truly multidisciplinary. The publication points per researcher (0.69) could be improved. Their outreach and willingness to collaborate is well developed and not only restricted to the local level. International academic networking is excellent. The number of dissertations (3) should be higher but it has to be considered that one of the professors just have been recently appointed (2007).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The researchers in the group seem to provide a very attractive and open research environment. They are able to attract senior researchers and PhD students from many countries. Their presence and recognition on the national and international level is evident. Long-term funding resources should be explored in order to create more PhD and post-doc positions.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The topics of research are of great relevance for the public, stakeholders and policy making bodies. In this regard the group is very influential as they are highly recognised as leaders in their field of expertise. They will extend their activities to future relevant issues such as economic impact of animal welfare policy implementation and food labelling.

The outreach is visible on all geographical dimensions. New facilities and a balanced mixture of animal scientists, biologists and veterinarians should enable them to provide them a long-term working environment. Members of the group are actively involved in the development of welfare policies of world organizations such as OIE, WTO and FAO.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The group has a promising vision and strategy for future directions. SLU should support their efforts to create another position with expertise in clinical ethology as this area of expertise within veterinary schools has been implemented in other welfare centres abroad. The creation of a behaviour and welfare centre of excellence should be formalised in the near future as the group might be better suited for this as other centres that are more or less built on loose connections between research groups that are not truly interconnected in common research efforts. The teaching load for highly active researchers should not be allowed to limit their capacities for innovative research as there is some competition with other state and federal research institutions outside of universities. Synergies between UoA's at SLU seem to be already utilised. International graduate courses offered at SLU should be a good resource for recruiting outstanding PhD students.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Participation of the unit in FOMA activities is not evident from the material provided.

B 4. Actions for development at the Unit of Assessment

Actions to further strengthen the programme should include the creation of a behaviour and welfare centre of excellence in the near future. Provision of additional staff (including core funding for PhD students) will be needed and experimental resources (as already initiated with the construction of Lövsta facilities) for basic animal behaviour and welfare research will be crucial in order to become an international centre of excellence (such as the group in Bristol) in this field. There is currently some risk that the group will spend too much time on international activities. Taken together with the teaching load, the researchers might only have time left for “on surface” problem solving of welfare relevant issues as their scope across animal species and disciplines is very broad. The University has to consider compensation for their significant contribution as scientific advisors for national and international authorities.

B 5. Additional information

The University should consider a foundation intended to raise funds for welfare research or even for temporary teaching positions. There are good examples for considerable endowment funds in other countries.

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 880_4 Production Systems

B 1. General assessment of the Unit of Assessment

This very motivated UoA is mainly concerned with applied research on beef and lamb production from grassland and on forage production for other farm animals. Their area of expertise is focused on nutrition management, feed evaluation and production performance, although there is little collaboration with other units dealing with ruminant nutrition. Their work seems to be appreciated by local stakeholder groups as most of their funding is coming from these groups. The unit is fairly small and not really well suited for production systems research as their focus is much narrower (nutrition). Their collaboration is limited because of their rather isolated location far away from the main university campus. However, the group is very active within these limits with some potential for synergy between research and environment monitoring and assessment. FOMA has granted research money to a project on “Long run environmental impact of technical and structural development of animal production” starting in 2009. The unit intends to pursue a holistic approach in order to develop competitive enterprises which are economically, ecologically and socially sustainable.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Originality of ideas in terms of scientific quality is difficult to identify as this is not their main focus. Their geographical scope is rather limited but is seen as something valuable for serving the industry in the region. There are efforts to collaborate with other units but these collaborations are more or less restricted to organizations within the boundaries of the immediate geographic neighborhood. The group sees some potential for collaboration with various disciplines within the Department of Animal Environment and Health, although it would be more logical if they would benefit from the expertise of the ruminant nutrition group. Their NCSf score of 0.75 is well below average, although there are efforts seen from the last few years to get papers placed at least in medium ranked journals which have the potential for international recognition of their work. Considering the small size of the group, they have been quite successful to create PhD positions as their level of funding coming from regional sources is sufficient to support their costs for farm operation and research work.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

Although the group seem to be very happy with their facilities and research efforts, their visibility in the scientific community and leadership in their field is rather limited. They are participating at international (at least European) conferences, but their international recognition does not seem to be at a high level. The group tries to strengthen collaborations with other research groups at Foulum in Denmark and at the Grange Research Centre in Ireland.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

As mentioned above, the unit has some potential for generating knowledge that will contribute to sustainable development of the industry, but this must be seen within the geographical limitations in which they operate which has little model character for other regions.

Geographical scope: regional; temporal dimension: medium-term

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

In order to reach a long-term competitive perspective, the group has to interact strongly with other units dealing with ruminant nutrition and meat quality as their expertise on that seem to be rather limited. The question is whether this will be successful when considering the rather remote location of the facility relative to the other units of the university. Production systems research necessitates a multidisciplinary input that might be better achieved within the boundaries of the university. If regional aspects and specific vegetation are in the main focus of that group, expertise would need to be added to this group in order to fill the gaps and enable them to become a competitive partner to other grassland research facilities abroad.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

No FOMA work was done during the period of evaluation but a FOMA project started in spring 2009. This will have to be followed up and evaluated in due course.

B 4. Actions for development at the Unit of Assessment

The group should aim for a network of expertise with other centres for grassland research outside of Sweden. As mentioned under 4. Strategy and Potential, the University has to assign additional competence and leadership (especially in nutrition) to the group if the regional and species specific (beef and sheep) aspects of this experimental unit are considered as important in order to serve the industry. On the other hand, the group could interact and benefit much more from the expertise of other SLU units that have a strong background in ruminant nutrition and management. Therefore, the integration and/or relocation of this unit closer to other relevant groups should be at least considered for the future.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 6. Animal Husbandry

Unit of Assessment: 882_1 Reindeer Husbandry Unit

B 1. General assessment of the Unit of Assessment

Established in 1994, the UoA has developed a multi-disciplinary research, unique in Sweden, including biological, economical and social aspects of reindeer industry, with a special emphasis on its sustainability and resilience. More social science research was conducted during the first 5-10 years, while more biological research has been performed recently. The research is primarily carried out as PhD projects, but no PhD thesis has been defended during the last 5 years. The senior staff of the UoA has established close contacts with the reindeer industry, but there is low possibility to access external funding through the professional sector. Due to its small size (5 persons) and highly diversified research topics, the scientific production of the UoA is rather poor and largely based on the publication of papers not in internationally ranked peer-reviewed journals. Collaborations have been established with other research groups within SLU as well as with other institutions involved in reindeer husbandry in Nordic countries, but it has not come out with substantial joint publication outputs. Based on the self-assessment report, bibliometric data and oral interview of the UoA, the evaluation panel has the strong impression that the UoA is playing a major role as adviser or extension centre rather than as a real research unit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The initial objective of the UoA was to develop multi-disciplinary research on the sustainability and resilience of the reindeer husbandry, as a key part of an indigenous people's livelihood and cultural framework. Many research topics have been, and are still investigated, from socio-economical aspects to biological issues, such as climate change, habitat fragmentation, large predator reintroductions, radioactive contamination, nutritional ecology, population dynamics, ecological modeling, etc. However, due to its small size, much diversified research and isolated position within the Faculty of Veterinary Medicine and Animal Science, and despite many scientific collaborations reported with other departments and faculties within SLU as well as with other Nordic institutions, the scientific productivity of the UoA is rather poor compared to the other UoA of the Animal Husbandry panel. The UoA is trying to maintain a balance between publications in internationally ranked journals and papers in a local (Nordic) scientific journal, not internationally ranked but closer to the professional audience. The consequence of this publication strategy is that most bibliometric

indicators (number of papers, h-index, normalized h-index, NCSj, NJCS, NCSf) are far below what is expected from an internationally recognized group.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA is actively participating to the scientific debate on sustainability of reindeer industry in Nordic countries and seems recognized by the other groups involved in this specific research area as a valuable partner. The senior staff is frequently invited as partner or board member of several international (Nordic) research or teaching projects and is recognized as expert or advisor in different research and development councils. However, the attractiveness of the UoA for PhD students is rather low, and no new recruitment has been done during the last five years. Recruitment of post-doc researchers is strictly internal.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA is playing a major role in the dissemination of research results within the reindeer industry and the Sami society, through frequent seminars, popular publications and web site. Its advisory role is well recognized by the public authorities, including the Sami parliament. In this respect, the senior staff is regularly invited by the Ministry of Environment as expert or consultant.

Due to the very specific research theme of the UoA, the activities are geographically restricted to the European Nordic countries and the natural distribution of reindeer populations. Few contacts or collaborations, if any, are established with North America where similar research topics are conducted.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy of UoA for future development seems to be largely dependent on the profile as well as research and development priorities of the new professor to be recruited from 2010 onwards. The present senior staff of the UoA strongly recommends pursuing the multi-disciplinary research developed by the UoA since its creation. The incorporation of the UoA within the Department of Animal Science should solve some of the problems generated by the present isolation of the UoA within the Faculty of Veterinary Medicine and Animal Science.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

However, considering the small size of the UoA, the difficulties to get substantial financial support from the industry sector, and despite the obvious need to investigate the sustainability of reindeer industry from a global perspective, the members of the evaluation panel are not convinced by the strategy proposed by the present staff. The major risk is that the new professor be not able to manage efficiently all these diversified aspects and, as a consequence, could not reach the international standards expected by SLU authorities.

Basically, two options can be envisaged :

1. to develop good scientific research on reindeer husbandry, including both basic and applied aspects, with the aim to work in close collaboration with an international (Nordic) multi-disciplinary network, allowing each partner of this network to investigate a specific theme. In this respect, the UoA should develop research in agreement with the other groups of the Department of Animal Science
2. to transform the present UoA into an extension centre in which the staff would continue to work as advisor for the industry and the public authorities, without developing a specific research submitted to classical criteria of scientific excellence.

The gender balance of the UoA is equilibrated but this is not a key issue in this evaluation.

On the basis of this evaluation, award a score from 1-6 ⁴:

2

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

If the research on reindeer husbandry and the support to the reindeer industry are among the priorities of SLU, the evaluation panel is recommending to reinforce substantially the UoA, particularly in terms of scientific and/or socio-economic human resources, and to integrate the UoA within an existing department, instead of maintaining it as an independent isolated unit. Funding from the industry will probably continue to be low, or could even decrease in the future. As a consequence, the research axes should be clearly defined in regards to the actual need of knowledge for the sector and to the research already performed by other institutions in neighbouring countries. Funding for collaborative research programme and networking through, for example, EC Life Projects and COST network could be searched.

In summary, multi-disciplinary approach can not be envisaged without increasing the staff of the UoA. Collaborations and complementarities of expertises between the different Nordic institutions are definitely needed. There also remains the possibility that this Unit is transformed into an extension/advisory centre.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 7. Biomedicine

The **Biomedicine Field** comprises 5 different UoA's that had been clustered for the purpose of the Assessment. Two of these units (Medical Biochemistry and Domestic Animal Function and Structure) belong at present to the Department of Anatomy, Physiology and Biochemistry, whereas the three other UoA's belong to the Department of Biomedical Sciences and Veterinary Public Health. These *ad hoc* clusters reflected the specific areas of expertise of the Panel members. However, it was a disadvantage to the reviewers when the self assessment reports did not fully expose areas of cooperation and integration within the existing Departments, and hence an assessment of such integration could not be included in the Panel's Report. Thus, synergies and desirable interactions with other fields within the Faculty of Veterinary Medicine could not be easily identified and indicated. Therefore, the following comments and suggestions about cooperation and strategic clustering and cooperation are confined to the UoA's allocated to this Panel.

The area of Biomedicine addressed here is certainly important, as it covers the basic disciplines such as anatomy, physiology and biochemistry, as well as the pre-and paraclinical subjects such as pathology, immunology and pharmacology and toxicology. The overall impression of the research quality, as well as recognition and leadership was very positive with some prominent highlights in terms of innovation and cutting edge research.

The Panel was able to identify various links that could be envisaged between disciplines. However, even more links with related fields (outside this cluster, but within the Faculty) could also be discerned. Common examples of such links, as established in other Faculties are cooperative and joint research programs between biochemistry and nutrition or biochemistry and immunology and host-defence mechanisms, pathology and toxicology, pharmacology and physiology, pharmacology and applied therapy, immunology and infectious diseases (bacteriology, virology, parasitology), endocrinology and clinical reproduction, to give just a few examples. In the process of re-defining the mission and objectives of current and new research programs and units, these natural links should be explored in more detail and taken into consideration during the development of new divisions and research clusters. In this way, the critical mass (HR and budget) could be improved without affecting the identity of individual units.

In the Self Assessment Reports of the research groups allocated to the Biomedicine Panel, coherence between individual lines of research and a clear presentation of future objectives and strategic moves towards these objectives were often lacking. This can partly be explained by the historical evolution of departments and the teaching obligations of the individual UoA. Thus, the recruitment of academic staff often appeared to be based on the teaching qualification of an individual candidate for a needed discipline or subject, and less strictly based on his/her research history and innovative approaches of a unit in the past, which can result in a negative consequence in research productivity.

Forthcoming strategic moves should aim at a more intensive utilization of highlights in fundamental research, and successfully established research areas. Moreover, amendments in

the SLU infra-structure and policy, including the establishment of shared, fully accessible service units with specialised (expensive) large technical equipment (and the corresponding technical staff, may stimulate trans-disciplinary cooperation and cost-effectiveness. These facilities are vital in the frame of the relocation of units that are currently working at BMC where they benefit from an excellent infrastructure and partnership. An additional asset would be the creation of virtual meeting rooms and conference facilities allowing joint seminars, joint lab meetings and even joint data assessments.

Moreover, SLU funded *Strategic Programs* involving different groups would greatly facilitate trans-disciplinary and trans-departmental collaborations.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

The scientific quality of all the UoA's is in the range of good to excellent. Details regarding lines of research, recognition and leadership of UoA scientists at the national and international level and the appreciation of the SLU activities by national and international bodies and the society at large, as a measure for the relevance and impact of the selected research areas, are reported with the assessments of the individual units, as given below. One of the most common statements made in all of the individual reports is that limited coherence is often found among the research lines within a specific Unit, and apparently limited cooperation across departments and units.

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Environmental monitoring and assessment (FOMA) is performed at SLU in a number of programmes. One of these programmes, the Animal Health Programme, intends to monitor the exposure of animals to naturally occurring and anthropogenic compounds, as well as the effects of exposure. Therefore, the FOMA programme has a clear connection to the UoA's of the biomedicine panel. However, as yet none of the individual UoA's reported extensive FOMA activities and hence only general statements expressing predominantly the view of the Panel members were included in the individual assessment reports.

B4. Actions for developments at the Unit of Assessment

While comments and recommendations are given at the level of individual UoA below, one of the most common statements made in all individual reports is the often limited coherence of the research lines within a unit and the apparently limited cooperation across departments and units.

B 5. Additional information

The SLU has a strong commitment in term of equal human rights and gender balance. This is clearly visible in the HR management. The Panel noted in the category of senior professors the traditionally high number of males, which is compensated for now by an increasing number of high-potential female staff members that have entered leading positions in all UoA's.

Part B: Report on individual Unit of Assessment

Panel 7. Biomedicine

Unit of Assessment: 712_1 Medical Biochemistry

B 1. General assessment of the Unit of Assessment

The mission of the UoA Medical Biochemistry is to define molecular mechanisms that are of relevance for diagnosis, prevention and treatment of mammalian diseases. Compared with biomedical research groups in university medical centres the UoA is rather small. However, this UoA is the largest when compared to the other UoA's of the Biomedicine cluster. Research at the UoA comprises 3 clear lines: (1) protein structure and self-assembly, (2) structure and activity of enzymes involved in nucleotide metabolism and (3) the role of mast cells in inflammation. Each research line is independent from the other two lines with respect to scope and attraction of research funds. The aims of each line are well defined and sound.

Research of the UoA is innovative and of a high level. The professors are leaders in their respective research fields. Although these fields differ considerably, the groups in the UoA benefit from the mutual interactions within the UoA. The groups also benefit from the interactions with biomedical researchers at the BMC. Researchers in this UoA have initiated collaborations with many national and international groups of high quality.

The three research lines are coherent and viable. The balance between basic and more applied research is good. Scientists of the UoA have started three companies (in 2001, 2003 and 2008). The companies ensure valorisation of the basic research, while maintaining a good balance between basic and applied research within the UoA. Several patents have been filed and more patent applications are underway. The UoA may fulfil an important role in the advancement of research and molecular thinking of scientists in other departments.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

1. Scientific Quality

The scientific quality of the UoA is excellent. The group performs well in comparison with other groups in Medical Biochemistry. Advanced, original, research is being done and the three subgroups have well-experienced leaders that move from strength to strength. The members of the UoA made several important discoveries. The number of acquired external grants is satisfactory, with most funds coming from the Swedish Research Council.

The production and quality of the scientific publications is in line with what can be expected from a medical biochemistry group. The unit publishes a considerable number of papers in journals of high impact. The number of citations that the published papers receive is good. In every research line, extensive collaboration exists with excellent scientists abroad.

Interestingly, of the five major scientific publications (2004-2008) that were listed by the authors, three had a corresponding author from a foreign group. The UoA produces 2-3 PhD theses per year.

In contrast to the international academic networks, the local networks within the SLU do not seem to be well developed. Collaborations with other groups within SLU exist but the number of joint projects seems to be low. This is understandable from the point of view of the biochemists, as the UoA prefers to focus its research on a limited number of topics in order to strive for excellence. Incentives to initiate the involvement of the biochemists in veterinary research are required. This could lead to a centre of excellence in molecular veterinary sciences without affecting the quality of research of the UoA in the biochemistry domain.

On the basis of this evaluation, the awarded score is

2. Recognition and Leadership

The scientists in this UoA are visible and esteemed in their research fields, as witnessed by the number of invitations to speak at international meetings, the organisation of symposia and memberships on editorial boards. The UoA certainly does not always lead the scientific debate in the respective fields, but in general the PIs are well recognised by their peers. The high quality research of the UoA constantly results in new projects that often involve collaborations with experts from renowned institutes. The fact that scientists of these institutes are willing to invest in joint projects is an indication of recognition and leadership of the members of the UoA. The many interactions with different scientific societies, is a witness to the broader role of the UoA in society, quite remarkable for a basic biochemistry group.

The UoA has a good ratio of senior staff to junior staff to PhD students. Almost none of the PhD students has a DVM background. Unfortunately, the panel did not have an opportunity to talk with post-docs and PhD students.

On the basis of this evaluation the awarded score is

3. Relevance and Impact

The UoA performs mainly basic biochemical research that is curiosity driven. Yet, the researchers in this unit show that they are well aware of the potential applications of their basic research. The UoA filed several patents and started three companies. Results from the basic research in the unit and the applied research in the companies may lead to new diagnostics and therapeutics in human medicine. Basic research in the UoA will benefit from the activities in the companies just as applied research in the companies benefits from the basic research in the unit. The UoA thus clearly contributes to the development of industry and society in general.

The relevance and impact of the research is global. Depending on the different products that may ultimately be made, the dimensions of this impact are medium- to long-term. The relevance and impact of the activities with respect to economic development and creation of jobs is local and of a short-term significance.

Some of this research, particularly those with significant collaboration, will have high impact at the international level and a long-term potential.

On the basis of this evaluation the awarded score is

4. Strategy and Potential

The future research potential of the UoA is excellent. The PIs have a vision and are able to attract research funds. However, the UoA also has a responsibility for the SLU at large. The potential of the UoA is not fully used with respect to the research to other research groups of the faculty. The unit may help scientists in other units setting up strategic research in bio-molecular sciences. Simultaneously, the unit should retain its identity as a division of biochemistry.

On the basis of this evaluation the awarded score is

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Participation in FOMA projects is feasible in the future and the unit may contribute to many methodological and technical aspects within these projects.

B 4. Actions for development at the Unit of Assessment

It cannot be expected from the scientists in this unit that they should always take the lead to initiate new research lines that are of clinical relevance. Therefore, excellent scientists from several departments of the faculty should be involved in the development of strategic plans. Only if a clear vision of future research of the faculty has been developed, the necessary steps can be taken to improve the contribution of the basic scientists in this UoA to the quality and depth of research of the faculty at large. Subsequently, in preparation for the move of this unit from BMC to Ultuna, the UoA could, together with researchers from animal sciences and from (para)-clinical groups, initiate research lines that are of relevance to these groups. In order to secure optimal collaboration it is advised to start to develop the strategic planning as soon as possible and not to wait until the UoA has moved to Ultuna. Since the move will affect the access to the equipment in BMC attention should be given to create a good infrastructure.

B 5. Additional information

This UoA has a strong potential to stimulate and improve the quality of the research activities of various other groups. The contacts and interactions with units in the biomedical cluster as well as clinical subjects should be stimulated. Because there is an obvious concern by this Unit about the potential loss of already well-established biomedical interactions after their move, consideration should be given to maintain and improve communication. Technical facilities such as *virtual conference rooms* allowing joint seminars, joint lab meetings and even joint data assessments can stimulate these interactions. Such technologies would allow for this productive unit to establish its presence at Ultuna but also to maintain its interactions with important biomedical scientists at BMC.

Part B: Report on individual Unit of Assessment

Panel 7. Biomedicine

Unit of Assessment: 712_3 Domestic Animal Structure and Function

B 1. General assessment of the Unit of Assessment

This UoA has a long history in endocrinology and reproductive physiology, which provides in the broad sense a common overall theme for their research activities. They have shown very good ability to collaborate, as exemplified by the good number of joint publications. However, the general discipline of animal structure and function is a declining research subject, as this area has essentially become incorporated into modern topics of organ physiology, toxicology and pathology. Although this unit has been successful in publishing research manuscripts, the number of papers appears to be increased due to their collaborations that are skills-driven, rather than projects that originated from the independent principal investigators of this unit. Thus, it will be a challenge for this group to focus on a highly visible and internationally recognizable program; yet, it has the foundation for the continuation of individual research associations with other units in a successful and strategically viable manner. The incoherence of the current organization may simply resolve itself by the merger of individual projects with other established research entities.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

1. Scientific Quality

This UoA has a rather broad focus but has made several interesting scientific discoveries. These studies overall are considered to be of moderate scientific quality. Although the scientific productivity has been very good, with the publication of between 21-29 manuscripts per year in good journals, the level of impact and prominence of this work appears to be of average substance. The publications are highly relevant within their discipline, but the papers are only occasionally found in highly ranked journals. In spite of this lack of high impact, the work is certainly of respectable quality, as evidenced by the unit having a good citation index score.

On the basis of this evaluation, the awarded score is

3

2. Recognition and Leadership

Some projects within this UoA are well recognized in the scientific community and internationally, such as the carbonic anhydrase (CA) studies, which involve histochemical enzymology developed by this group. This specific research is readily cited in the literature and demonstrates the ability to generate new knowledge but the unit has not shown leadership

in further development of the CA research for application in new areas of study, such as in cancer and kidney pathology and basic biochemistry. External research funding for this UoA has been very low, with only the project on phytoestrogens and eggshell formation and bone strength being currently funded. Nevertheless, the group has demonstrated in the past the ability to form significant international scientific collaborations including the Netherlands, Italy, USA, Denmark and Poland. These collaborations have led to at least 10 international invitations to speak. Three of the researchers are members of Editorial Boards of veterinary journals and one Lecturer is President of a European Society. Thus, this Unit has performed highly commendable efforts to establish significant collaborations with a large number of institutions and international scientists, which has provided important recognition. However, these collaborations have not led to significant establishment of leadership within the UoA to provide an attractive environment for independent and sustainable research.

On the basis of this evaluation the awarded score is

3. Relevance and Impact

This UoA has noteworthy skills-driven talent that has cultivated significant collaborations in research. However, without an effective focus and development of new hypothesis-driven projects, it is not clear that such collaborations will indeed lead to a sustainable generation of knowledge and development of highly significant contributions to society and industry. There was mention of possible spin off research, but details were lacking for such potential contributions to industry. Nevertheless, the general research theme of this UoA being “endocrinology” is highly relevant to research in veterinary medicine and opens the door for potentially important applications in the area of environmental monitoring and a significant opportunity for participation in FOMA projects. Thus, there could be long-term potential for the integration of endocrinology, reproduction and toxicology, which could lay the foundation for the generation of knowledge capable of contributing substantially to society and industry.

Comment on the *geographical* and *temporal* dimensions.

Some of this research, particularly those with significant collaboration, will have high impact at the international level and a long-term potential.

On the basis of this evaluation the awarded score is

4. Strategy and Potential

The goals and strategy put forth by this UoA are too general and appear to be only a compilation of individual projects. Individual skills are present within the group, but scientific vision for how to sustain a research program appears to be lacking. It is unclear whether the unit will have the competence, influence and funding to carry out the proposed research programs. The proposed future research directions consisted of very general statements of research ideas without sufficient detail. Although the UoA has proposed to continue their well-established collaborations, no clear strategy was presented to achieve the funding and training that would be necessary for maintenance and renewal of these projects.

On the basis of this evaluation the awarded score is

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Future participation in the development of FOMA projects would seem appropriate for members of this UoA, as their ability to assess endocrine changes in environmentally relevant species and the monitoring of reproductive health in these species would utilize their respective talents with significant benefit to society and Swedish National interests.

B 4. Actions for development at the Unit of Assessment

The UoA has a unique potential to strengthen its research by focusing more clearly on its common theme of endocrinology and linking its activities to the rapidly advancing field of “reproductive and endocrine toxicology.” Future participation in the development of FOMA projects would seem appropriate for members of this UoA, as their ability to assess endocrine changes in environmentally relevant species and the monitoring of reproductive health in these species would utilize their respective talents with significant benefit to society and Swedish National interests.

B 5. Additional information

This research unit obviously has a high teaching load, which is inherent to a basic discipline like physiology. Strategic cooperation with other units such as pharmacology/toxicology, as well as biochemistry, in the area of teaching, and with toxicology and clinical reproduction for joint research activities would increase the competence and critical mass of this group. The use of “virtual classroom” technologies could help to free up time for research, help to maintain cross-discipline collaboration, as well as improve teaching by making it more asynchronous. For example, virtual microscopes are now available for use with the internet browser, which saves time teaching histology and pathology, but also improves collaboration with colleagues in other locations, even other countries.

Part B: Report on individual Unit of Assessment

Panel 7. Biomedicine

Unit of Assessment: 713_4 Pharmacology and Toxicology

B 1. General assessment of the Unit of Assessment

This unit has a long tradition in innovative research in specific areas particularly in the field of pharmaco- and toxicokinetics. The focus on this area, which is a common theme in the field of pharmacology and toxicology was an important and well justified decision, especially in consideration of the limited size of this group. The UoA has published a number of well received scientific papers as indicated by a good citation index. The number of publications shows a significant increase over the last years and is published in Journals recognized in the field.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

1. Scientific Quality

The scientific output over the years has been sound and of good quality. Recognition in the field has certainly benefited from some true innovative approaches, such a whole body radiography, which was (and still is) unique in demonstrating the distribution of a drug or toxin to individual tissues and its potential accumulation in certain organ structures. Moreover, the focus on extra-hepatic metabolism and the retrograde transport of drugs along nerves to the central nervous system. More recently, this unit has focused on biotransformation and efflux transporters in horses. Horses, being companion animals, athletes and food producing animals (including the production of equine milk for sensitive consumers) require specific attention by academia and regulatory authorities. Focus on this species is thus justified and contributes to optimal therapeutic intervention strategies.

The UoA has established some successful cooperation with other European groups who are active in the same field and participated regularly in joint activities, such as Congresses and Working parties. The small size of this group, however, appears to be a limiting factor that is hampering a broader international recognition. An improvement of collaborations within and outside SLU could possibly compensate for the limited number of researchers in this UoA.

On the basis of this evaluation, the awarded score is

3

2. Recognition and Leadership

Despite the fact that this UoA has always been small, their international visibility has been good, particularly with regards to the above-mentioned areas of specific expertise. At the national level, there is both recognition and appreciation of the unit's research as an outstanding source of sound and reliable information regarding the use of medicinal products (see also section 3). At present the UoA is in a transition period, as two senior professors who

have shaped the group in the last decade have retired or are about to retire. However, the group has a high potential, and national and international recognition and leadership will become even more visible when a new team is established and international cooperation is expanded.

On the basis of this evaluation the awarded score is

3. Relevance and Impact

The relevance and impact of the research performed by this UoA is high, as clearly indicated by the stakeholders, particularly the Medicinal Product Agency. Knowledge in kinetics, drug transport and PK/PD modelling is essential not only for the process of drug licensing, but also for the control of a correct and safe use of medicinal products in daily practice. In particular, the use of medicinal products for minor indication or in minor species, where a formal licensing procedure is not feasible on short notice, requires the advice of independent veterinary pharmacologists. It is also an important area for the prediction of undesirable (adverse) drug actions and contributes to the area of post-marketing pharmaco-(and toxico-) vigilance. An indicator of the relevance of the expertise as present in this UoA is the fact that various previous staff members have obtained positions at the Medical Products Agency.

Comment on the *geographical* and *temporal* dimensions.

Some of this research, particularly those with significant collaboration, will have high impact at the international level and a long-term potential. The impact of the research field is high for the veterinary community and the successful and safe use of veterinary medicinal products. The impact reaches national and Nordic/European areas, particularly regarding all short-term implications mentioned above and long-term perspectives concerning target animal welfare and health and (EU) food safety objectives.

On the basis of this evaluation the awarded score is

4. Strategy and Potential

The senior professor and current head of this UoA indicated his intention to retire in the autumn of 2009. Given the relevance of the discipline, and the good potential for the group to improve output and quality in the selected research area, a strategic plan should be developed. The size of the group could be expanded through structured cooperation with other units within the Biomedicine cluster of the SLU. Obvious partners are the Domestic Animal Structure and Function unit, which is approaching various areas of (environmental) toxicology with a focus on endocrine effects and impairment of reproduction. Methodologically the group should seek a closer cooperation with the Biochemistry Unit.

On the basis of this evaluation the awarded score is

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Future participation in the development of FOMA projects would seem appropriate for members of this Unit, as their profound knowledge of the kinetics and mechanisms of action of toxins and bioactive (undesirable) contaminants could provide valuable input in all areas of

assessment and monitoring of environmental pollutants, with significant benefit to farm animals, wildlife and public health.

B 4. Actions for development at the Unit of Assessment

As mentioned above, the unit needs to develop in the forthcoming years a new and innovative strategy and maintain and improve local (within SLU) and international cooperation. In addition, the UoA would benefit from a formal cooperation with the Medical Products Agency.

B 5. Additional information

Considering the high relevance and impact of this UoA, it is recommended that they define a profile for head of unit, as soon as possible (given the fact that the current head of unit is soon retiring), to avoid a vacancy in this position.

Part B: Report on individual Unit of Assessment

Panel 7. Biomedicine

Unit of Assessment: 713_5 Pathology

B 1. General assessment of the Unit of Assessment

This is a unit that has a strong research activity with a long history, a good track record of publication and a strong international standing. However, seen as a unit this group is lacking coherence, representing in reality three lines of pursuit without obvious links and visible overlaps. Two of the research areas have in common the theme *inflammation*. When the three lines of activity are examined individually, they all give an impression of being of adequate to very good substance and originality, good to very good penetration and of good to excellent international standing. The spider silk project stands out as an exceptional example of innovative research with global implications.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

1. Scientific Quality

The publication record of the inflammation groups within the UoA reflects a historical strength in descriptive, case-oriented pathology. A deliberate effort aimed at building national and international networks and updating research tools has successfully improved their impact and focus in conjunction with a stronger emphasis on experimental work. Most decisively, the scientific quality within this unit has recently benefited from the fact that the coordination of the spider silk project has been allocated to the UoA.

On the basis of this evaluation, the awarded score is

4

2. Recognition and Leadership

The three different lines of pursuit in the UoA all stand well on their own merits, each providing a solid package of information and knowledge to the (scientific) society in their respective fields. The chosen themes and acquired expertises meet the demands of different groups and are of general interest to animal welfare, veterinary medicine and public health. The recently acquired research of recombinant spider silk as a biomaterial and starting material for tissue engineering has achieved worldwide recognition. This offers a unique opportunity for an international cooperation and a close exchange with other colleagues of the unit.

On the basis of this evaluation the awarded score is

4

3. Relevance and Impact

The UoA has a strong potential for supporting and contributing to sustainable development of the society. The potential of the spider silk project should be mentioned specifically, as it could lay the foundation for a new industry. The future will predictably present new challenges with respect to animal disease that require a unit with strength and credibility to identify new causes and mechanisms of disease. Parasite host-interactions as a broader research field holds promise and potential to provide scientific breakthroughs, as do studies of connective tissue diseases.

Comment on the *geographical* and *temporal* dimensions.

Each of the staff members within the UoA has a very good standing in their respective field of expertise, both at the national and Nordic/European levels. To maintain this status in the future a stronger coherence between individual research activities and clearly defined common objectives should be developed within the UoA.

On the basis of this evaluation the awarded score is

4. Strategy and Potential

The unit has great research potential; however, to reach such potential will depend upon decisions that identify and take into account circumstances that at present limit their output in scientific publications and joint programs. Each of the three lines of pursuit within the UoA has a vision of the future but a clear, unifying strategy for the unit is lacking. Strategic planning should aim at identifying the common research goals and how to achieve them.

On the basis of this evaluation the awarded score is

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Future participation in the development of FOMA projects would seem appropriate for members of this Unit, as their profound knowledge in pathology comprises an invaluable service in the assessment and monitoring of environmental pollutants with significant benefit to farm animals, wildlife and public health.

B 4. Actions for development at the Unit of Assessment

The future undoubtedly will continue to present a strong demand for insight into tissue events that characterise disease. However, the maintenance of originality, relevance and impact in research within a classical discipline like pathology is a real challenge. Descriptive work will continue to have a central role in pathology, but it should be nowadays be supplemented with molecular approaches and mechanistic studies. Efforts to structure and focus the research activities of this UoA have in part been successful but could be improved by a stronger emphasis on hypothesis-driven research. Moreover, the development of the molecular tools within the context of the proposed studies should be supported. Implementation of the field of molecular pathology can be achieved by establishing good networks at the national and international level.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 7. Biomedicine

Unit of Assessment: 713_9 Immunological Veterinary Medicine

B 1. General assessment of the Unit of Assessment

This UoA has a long history of successful research on type I interferon in both medical and veterinary disciplines. It recently conducted research in two main, but rather divergent directions, (i) autoimmune diseases for medical purposes and (ii) molecular and cellular interactions of animal pathogens with the immune system of several domestic animal species (also called, “veterinary immunology”). The decision to move Prof. G. Alm’s group to UU has had profound consequences on the UoA, both in terms of human resources and long-term vision. As a consequence, the current reduced size of UoA is a matter of concern, although the Veterinary Immunology Unit has a major mission to fulfil within SLU and the Ultuna campus as a facilitator/promoter of trans-disciplinary and collective projects in the essential fields of animal infectious diseases and welfare.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria

1. Scientific Quality

Despite some heterogeneity related to the different fields covered, the UoA has an internationally recognized, innovative and high impact record of scientific productions. It has been successful in initiating new and attractive concepts, using updated methods, and building an efficient network of international partnerships.

On the basis of this evaluation, the awarded score is

4

2. Recognition and Leadership

To date, the UoA’s recognition and leadership has largely centred on the person of G. Alm, who initiated the Department of Veterinary Immunology and successfully linked it with medical and basic research within BMC. The current head of the UoA, C. Fossum, is internationally recognized for her contributions to the field of veterinary immunology, as further evidenced by her active participation in European (board member of the European veterinary immunology group) and international committees. Moreover, The UoA has established a number of important collaboration projects with bodies such as the National Veterinary Institute in Sweden, thereby combining basic and applied research. A prominent example is the porcine circovirus project. Results from these studies are highly relevant and the treatment recommendations will have a direct impact on animal health stakeholder organisations.

On the basis of this evaluation the awarded score is

4

3. Relevance and Impact

Veterinary immunology is of very high relevance and impact for

(i) the Veterinary Medicine and Animal Science Faculty, regarding the development and identification of relevant research areas (for example in the control of animal infectious diseases, animal welfare, environmental hazards), (ii) the SLU campus for maintaining and strengthening its links with SVA, (iii) the national food animal producers in addressing essential issues of new and economically threatening infectious diseases, and (iv) the national/international veterinary pharmaceutical companies.

The UoA has clearly the potential and the scientific expertise to address such important challenges, provided that the current issues of critical size, human resources (PhD students and post-doc scientists) and future leadership will rapidly be resolved.

Comment on the *geographical* and *temporal* dimensions.

Each of the staff members within the UoA has a very good standing in their respective field of expertise. The therapeutic strategies currently under clinical trials aiming at the control of autoimmune diseases have a global and medium-term dimension. The projects directed to a better understanding of the interactions between economically important animal pathogens (e.g. PCV2) and their host's immune system, or towards the improvement of veterinary vaccine strategies (CpG motifs, ISCOM methodology) have both national and European dimensions and long-term perspectives.

On the basis of this evaluation the awarded score is

4. Strategy and Potential

The UoA has gained the expertise needed to develop new and realisable research projects in the field of animal infectious diseases, animal vaccinology and immunology. The presence within the same unit of immunologists and virologists is clearly an advantage, as the fact that the UoA has established efficient and long-term partnership with SLU and SVA microbiologists. However, in the absence of perspectives regarding the appointment of a new Professor in Veterinary Immunology, the UoA was not able to propose either a scientific plan or a vision for its future development. Renewal of human resources including recruitment of younger staff members is clearly a major challenge.

On the basis of this evaluation the awarded score is

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Future participation in the development of FOMA projects would seem appropriate for members of this Unit, but the degree of activity will depend on the future research areas to be identified by the UoA.

B 4. Actions for development at the Unit of Assessment

It is inevitable that this UoA focus on a limited number of animal models for ensuring expertise and competitiveness and concentrate on a reduced number of scientific questions (e.g. pathogens interactions with antigen presenting cells). Moreover, there is a need for improvement in the collaborations between SLU and UU in the field of immunology. Addressing the issues of critical size, renewal of scientists and appointment of a Professor in veterinary immunology are key elements that would be required to ensure the re-building of the UoA with new scientific strategic plan to guarantee its future development.

B 5. Additional information

Amendments in the SLU infra-structure policy and achievements, including the establishment of shared, fully accessible, service units with specialised large technical equipment and the corresponding technical staff, may stimulate trans-disciplinary cooperation and cost-effectiveness. Such a need is very prominent for the success of relocation within Ultuna campus of the UoA currently working at BMC where they benefit from excellent infrastructures and partnership in basic immunology. For the same objective, launching a new round of SLU funded "Strategic programs" should greatly facilitate trans-disciplinary and trans-department collaborations.

Report - Part A: General Assessment of the Research Field

Panel 8: Forest Management and Products

The research programs and strategic directions address a broad range of relevant issues in the context of forest management, forest utilization and forest products. However, the overall appearance is somewhat “scattered”, with considerable overlap and some duplication of research. While such overlap is not always detrimental and can often result in valuable synergies, the panel feels that there is a role for more coordination of the research efforts and a proactive attitude of the university to help develop collaborations that can bring about synergies between the various research units. A large part of the research themes and organization has been influenced by the personalities of senior professors and researchers, as well as location, and not so much by strategic scientific coordination by a department, faculty or the university. Through the evaluation of the UoA’s there appears to be an imbalance in teaching and research, where some research units would like to teach more and the teaching would benefit from that, while others claim overloading with teaching duties. As with research, a better coordination of the teaching in SLU is needed.

The panel is of the opinion that the major subject areas in the field of forest management and products are well covered. However, in several of the self-assessments, and during the interviews with the UoA’s, it was apparent that policy research and the social sciences need to be better incorporated in the forest sciences research agenda; that means, not only with a clear organizational structure but also with a clear set of specific research questions and hypotheses, and clear inter-linkages to the other research fields. It is not clear whether this should be done by building the research expertise in policy and social sciences directly into the forest sciences departments or by coordinating collaboration with relevant units elsewhere within SLU and other universities.

Some of the key areas in forest sciences (e.g., Wood Science and Fibre Biology, Remote Sensing, Forest Management) have received high scores. But there is large variation in research quality, quantity, and impact and relevance between UoA’s. Some units have too broad of a research agenda and need to be more focused in order to become high achievers in their respective fields of research and thus internationally recognized. This is especially true for many of the UoA’s that are very small. In general, larger research teams are required to develop international recognized centres of excellence in a particular field.

The panel feels that external funding is high within the units assessed. However, opportunities should be explored to increase the amount of funding received from the EU.

In regard to FOMA, the UoA’s recognise FOMA as an important part of SLU that provides synergy with scientific research.

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 210_1. Forest, Landscape and Society

B 1. General assessment of the Unit of Assessment

The panel found it difficult to evaluate this UoA on its scientific merit. Although bringing social issues into sustainable forest management is important, the science in the methodology and results presented by the unit was unclear. The panel was left hanging on whether the research being undertaken is in the field of political science, sociology, or some other field of the social sciences. The panel did not find any explicit research questions or scientific methodology, other than the seven step process for engaging stakeholders. The impression was that the “research” was purely curiosity driven, concentrating very much on data/information collection (inductive research) from which trends and relationships may be found. While this exploratory approach to research is fully acceptable as one among various approaches, it is difficult to accept it as the only or best one. The self-assessment was vague and unclear, and did not demonstrate the quality and applicability of the research. The UoA elected to not give an oral presentation, which the panel feels may have helped in regard to the previous comment. Another difficulty is that none of the panel members are social scientists. This unit is quite new and is developing. Research productivity during 2007 and 2008 has been lower than in previous years.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Funding for this unit has been received from the Wallenberg Foundation with a very open mandate. This gives the opportunity for the UofA to carry out very open-ended basic research that can potentially lead to ground breaking knowledge or methodologies to enhance sustainable forest management and linking it to social issues and needs. However, we are unable to vindicate this assumption. This is a very new group that is developing its scientific quality and impact. Based solely on the evaluation indicators of quality of scientific publications or other output, competitive national or international research grants, number of PhD exams, national or international centres of excellence, as well as major national and international collaborations, and applying these indicators only to work currently carried out by the UofA the panel can only give a score of 3.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UofA is actively involved in the sustainable forest management debate in Sweden. It is currently striving to add a scientific component to the debate through the development of its 7 step process to engage the public. The development of scientific information in the area of the social issues and sustainable forest management is very valuable.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Due to the inductive approach to the research to-date it is unclear at the moment what the full potential of the current research is and will be. There is the potential though, for this UofA to provide valuable knowledge to bring in the social aspects to sustainable forest management that impact both society and industry. The debate in regard to including social issues continues to grow and thus this is an important area for research.

The UofA is very active in Sweden, Russia, Belarus and Poland, with a view to bring in the short to long-term perspectives in sustainable forest management to the larger boreal forest context. This international approach is promising.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

As mentioned above the UofA is a fairly new entity that is developing its research program, agenda and expertise in a field that is not “black and white”. The UofA has given a very detailed outline of its strategic goals and directions. The review panel had difficulty in fully assessing the UofA’s research quality and potential, but realizes the importance of the future activities outline. However, the panel is still not clear of the scientific methodology or data/information analysis techniques that will be followed to achieve the goals outlined in the self assessment, nor whether all of the goals will be achievable.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable. The unit has no FOMA funds. However, it maintains that FOMA activities are carried out. The panel judges that the majority of these activities are research. Only standard assessments should be considered as FOMA.

B 4. Actions for development at the Unit of Assessment

The UofA needs to clearly define the research questions and issues they are focusing on, as well as the methodology for the data collection and analysis. This information is critical for the UofA to better explain the significance of its research to stakeholders unfamiliar with their field of research.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 231_1 Wood Science and Fibre Biology

B 1. General assessment of the Unit of Assessment

The leader of the UoA and two colleagues gave an excellent comprehensive presentation of the activities and projects of the unit. The research profile of this UoA is excellent with very good productivity both qualitatively and quantitatively. It has a great dynamism, high relevance and important scientific objectives. The UoA carries out basic to applied research on wood and wood fibre based products with the aim of increasing knowledge on the raw material, its properties and use. It has both a “curiosity driven” (wood anatomy, ultrastructure, chemical and topo-chemical analysis) and a “needs driven” (wood protection, wood technology) research profile. The multidisciplinary methods used are original and well adapted for going from the nano-level to the macro wood material level. They work with several industries and their potential for transferring sustainable knowledge is judged to be very good.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA follows an original research strategy (from ultrastructure to wood material) using modern ideas (e.g., use of Carbohydrate Modules Domains (CBMs)). We feel the researchers are Scientific Leaders (WURC Centre of Excellence, European COST Actions, etc.) and have developed several interactive Swedish collaborations both with SLU laboratories and units, and outside. The UoA has introduced the best modern equipment such as a FE-TEM. The researchers have adopted a multidisciplinary approach to carry out innovative research using modern research techniques and methods. The scientific productivity is very good, diversified and very often in high-level journals. The UoA appears to have very good national, European and international impact (e.g., national and international collaborations, several national grants (government and industries)).

On the basis of this evaluation, award a score from 1-6¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

There is good external recognition of the UofA as evidenced through external consultancies, European assignments, participation and management of a Centre of Excellence (Vinnova), networks, election to International Academy of Wood Science (IAWS), two awards to Jonas Hafren, and invitations for oral presentations. The UoA works closely with industry and provides expertise on wood and fibre structure, does the strength testing and wood degradation testing for the Wood Technology group, and has engagement with government organisations and international collaborations. There are currently three PhD students in the UofA and there is the desire to increase this to eight. The researchers are well aware of the research and development, research teams and networks, and researchers working in the same field internationally.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA has an excellent peer reviewed scientific publishing record. Applying a strategy of research and technology going from nano- to macro-scale of wood materials, the UofA has produced numerous project reports in collaboration with industry and results from these collaborations are being implemented in practice, as evidenced by the continuing working relationship with the industrial partners. The UoA works closely with the Wood Technology unit, and carries out any wood mechanical testing required, as well as decay resistance testing. The UofA has been awarded one patent and four patent applications have been submitted. The quality of the PhD students being trained in this UofA is evident from their employability upon graduation. There is also collaboration with non-academics and with two developing countries (Nigeria and Mozambique), thus also actively contributing to educating high-level scientists in developing countries. It is also clear that the research is not focused only on the national agenda, but also has a European and international dimension.

Comment on the *geographical* (a: regional/national; b: Nordic/European; c: global) and *temporal* (a: short-term; b: medium-term; c: long-term perspective) dimensions.

See above.

On the basis of this evaluation, award a score from 1-6 ³:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The future research potential seems excellent but would be especially enhanced with the hiring of an additional senior researcher (professor). Having professors both in wood science and “fundamental” wood technology would enhance this UoA. This would also improve the attractiveness of the unit for recruiting high quality PhD students.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable.

B 4. Actions for development at the Unit of Assessment

There has been excellent development of the unit to-date, so keep on the same track with clearly focusing on natural niche areas. As mentioned above a second professor in the unit, focusing on fundamental wood technology, will be a major asset for future development of the research agenda.

B 5. Additional information

Strengths: Both fundamental and applied research; Leaders of Centre of Excellence, are running and responsible for CRUW (fundamental collaboration of several laboratories and Swedish industries); able to obtain a variety of funding; several national and international collaborations; introduction of new developmental research areas (biosynthesis and molecular biology, bioengineering of fibre material)

Weakness: other comparable institutions in the world; the “niche” has been limited to coniferous species and has only starting to work with hardwoods; not enough teaching to undergraduate and master’s students

Opportunities: Great potential due to the specificity of the approach at the nano-level of the internal structure of cell wall (e.g., 3-D modeling of cell wall structure) and topo-chemical composition. By many aspects, this unit is a leader in the techniques used.

Threats: We have a small feeling that if this group becomes to rely on too many collaborative programs, a part of the originality of the research may become dependent on other laboratories’ competences (e.g., genetic studies in Umeå: Bjorn Sundberg Lab.). This is not a major threat, just something that needs to be kept in mind.

GENERAL COMMENT: Excellent UoA with very good productivity, great dynamism, high relevance, important scientific objectives and excellent future potential.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 231_2 Wood Technology

B 1. General assessment of the Unit of Assessment

The research profile of this small sized group should be more focused in areas where the UoA can defend long term and well recognized areas. In this Group working mostly with applied objectives (raw material and wood properties), scientific domains should be in more precise fields than in the large number of “little topics”, not necessarily related to one another. One possible domain could be “Measurement and Classification” for example. Most of the researchers are approaching the end of their career (over 60). This presents an opportunity to direct the unit into strategic niche research areas. There is currently a professorial search in progress and it is recommended the unit be very strategic in filling the position.

Internationally there is a major move to value-adding and the development of novel wood products and building technologies that do not exist today. This appears to be a gap at SLU though it may be covered at other Swedish universities. Another point of advice would be to strengthen the collaboration not only with other UoA’s like Wood Science and Fibre Biology, Forest Management, etc., but also outside SLU with relevant partners. The UoA also has to seek a better balance with own curiosity driven R&D, which currently appears limited, and outside demands/influences.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

One of the important research areas of the UoA is in trying to establish the relationship between raw materials and wood products. However, much of the research appears to be too sporadic and focused on narrow current issues. The UoA has to create a more long term strategic vision for its research and development projects. Focusing in on niche areas where there is strong capacity and impact would be one strategy. The capability to establish good research constellations/networks and cooperation with the industry seem to be good, and specific project expectations have been achieved. The UoA has a limited European visibility (one ongoing EU project) and its international impact is difficult to evaluate. Concerning education, there is a good training of students for the wood products industry, but the academic network is limited to national level. There are reports for education productivity in the self-assessment, though none for scientific productivity. The review panel is of the opinion that scientific productivity could be significantly improved through some strategic allocation of resources and strategic level guidance.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA is very depending on their graduating students to bring out their message. In certain areas like “storage of wood” the UoA has a leading position. But their overall recognition and leadership position needs to be strengthened. The close cooperation with the industry creates a good environment for research within specific fields and projects.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The potential for the future is good but the ability to achieve it is, as outlined above, very much dependent on the upcoming recruitment of new key-personnel.

The geographical relevance for the future can be expanded from national to Nordic/European, and then to international. However, it is imperative that a long-term timeline be incorporated into the strategic vision of the unit. This is essential to have significant impacts on developing forest products for the future.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Developing the study of the relationship between raw material and wood properties in view of a better “smart way” seems to be a realisable potential in the UoA. This corresponds to a real societal and environmental need, as well as the future viability of the forest industry. Sweden’s forest and wood resources are of high quality, but can be variable. Guiding the focus and increasing the capacity of the unit toward research in and development of new value-adding forest products may be one strategy. The gender balance is fine and efforts should be made to keep it like that. The synergies with other SLU units could be exploited even more.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not active so far.

B 4. Actions for development at the Unit of Assessment

The UoA should try to establish a broader mix of competences within the group.

Prerequisite for favorable development:

The group should focus on more selective niche research areas that have high potential and priority for society in general and the industry in particular. These need to match the capabilities of the unit, but new hires could be used to strategically position the unit. The unit is currently strong in storage methods and technology, and this could be further developed. In addition to the value-adding research mentioned above, the relationships between silvicultural treatments/decisions and wood material properties is another potential area.

A strong collaboration with other scientific groups (Wood Mechanics, etc.) could be beneficial.

B 5. Additional information

During the interview the unit representatives were unable to give an explanation to the question of why the rate of external funding is so low, when the consultancy work seems to be rather extensive.

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 231_4 Forest Policy and Global Forestry

B 1. General assessment of the Unit of Assessment

The UoA was formally established in 2006 as a Faculty initiative. At present the size is only 4 researchers but not all of them are working fulltime with research. The panel is of the opinion that Sweden should have a strong forestry and related policies research program.

The self-assessment has major shortcomings. Because of that it is extremely difficult for the panel to make a satisfactory assessment. The output 2004-2008 is limited and scattered. There has been one thesis on the UN forestry process and another on forest policy development in Eastern Europe. Work on Swedish forest policy has mainly been descriptive. Only two scientific papers have been produced. Two new theses are under way, one on forest policy making in the EU and the other on state donor agency relations. The research quality is difficult to assess.

The panel and other research units interviewed recognize the need for a strong program of research on forest policies and governance, but emphasizes that this cannot be done without taking into account other policy areas, e.g. environment, energy and tax policy.

The panel believes that the name of the unit “Forest Policy and Global Forestry” is misleading and suggests that it should be changed to “Forest Policy”.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

It is difficult to assess originality of ideas, choice of methods and scientific productivity. The impact on policy processes appears to be marginal, although some non-scientific work has been used in energy policy-making. According to the bibliometrical analysis the UoA has not reached either national or international prominence. It is not foreseen that national and international prominence will be reached in the near future.

Lack of information makes it difficult to judge if the UoA has succeeded in establishing cooperation with researchers at other domestic or foreign universities. The panel has got the impression that this has not been the case, but this has to be confirmed. It also seems that the research work is mainly “single-person” focused work, not particularly favorable for PhD students. However, the UoA has recruited relevant external supervisors for recent PhDs.

The geographical scope has been broad with the main focus on international and regional (Europe) policy issues. At the national level the research has up to now been too descriptive.

Based on the self assessment, and interview with the UoA, it appears that the networking and collaboration activities have been marginal both nationally and internationally.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The panel has found that the UoA has showed low ability to lead the scientific debate so far. No effective measures have been taken to provide an attractive research environment.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The panel has found that the research carried is relevant, possibly with the exception of the descriptive work on Swedish forest policy. It cannot be said that the work has raised the competence, profile and recognition of the research team. The impact is difficult to assess but is probably low. The future potential for generating valuable knowledge at the national level could be high if the research is focussed on policy process analyses, and on policy evaluation using both quantitative and qualitative methods.

The UoA has identified four research areas: 1) legislation and tenure paradigm shift after 1993; 2) small forest owners' perspectives and policy issues (objectives, advice services, rural development); 3) international forest policy; and 4) forest and environmental ethics. The first two cover the national, and the third the European and the global perspective. The fourth relates to forestry in the broad sense of sustainable forest management. The panel finds in principle this coverage is appropriate. However, in the past too much focus has been put on the international research area.

The research during 2004-2008 mainly addresses policy issues with relevance 10-15 years ago. Considering the small research group this is judged to be a reasonable delimitation.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

No well thought-out vision and goals, and strategies to achieve the goals, have been shown. Therefore it is difficult to comment on this (see also under B4). There are no reasons why this UoA could not become a nationally and even international recognized leader in forest policy research. However, it is essential to recruit a highly competent professor when the present professor retires within a few years. Coming up with clear research focus areas is essential, as well as a strategy to reach the goals. With a clear vision and direction, recruiting highly qualified PhD students and post docs would be easier and the unit size thus improved.

There are many units at SLU dealing with policy issues in one way or another, but more from a perspective of how forest policies and governance impact them. Through cooperation with other units there is great potential for this unit to establish a relevant research program on the actual policy formation, policies and governance.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

- Strategically invest into the research over the next two to three years with the purpose to establish a good staffing and environmental basis for future research
- Recruit a highly competent professor when the present one retires. This could be part of the strategic investment to avoid a two to three year time lag.
- Switch the focus from international to national forest policy research.
- Be more analytical and less descriptive in the research on national forest policy.
- Formulate both a vision and goals as well as elaborate a strategy to reach the goals.
- Make it clearer that the research is not only dealing with forest policy but also with other policies that affect the forest policy and forestry.

B 5. Additional information

Small-scale, non-industrial private forest policy research is also carried out at the UoA 295_2 Forest Planning South. The panel considers it necessary that having two units doing the same research is redundant. Such a small research area in forest policy requires good collaboration or consolidation into one organisational unit.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 241_1 Forest Management

B 1. General assessment of the Unit of Assessment

This UoA covers a large part of the Department of Forest Ecology and Management in Umeå, with five research areas (silviculture, growth and yield, tropical forestry, regeneration and forest ecophysiology). The recent merger of three departments (forest management, forest soils and vegetation ecology) had the aim to create a functional link between the more applied and empirical parts of forest management, and the process-based research within the area on soil processes and plant eco-physiology. This combination provides synergy between the different fields, creates a critical mass for high-level research, and allows for a fruitful interaction between applications and basic research. The UoA represents components of both.

The research environment of the unit consists of the other Forestry departments in Umeå, as well as relevant departments of Umeå University. The infrastructure within this unit of UoA is nationally and internationally unique and instrumental to large parts of the research. They have access to long term field experiments both inside and outside the unit for field-based research, as well as research laboratories at the department. In addition, they have functional collaboration with other departments of the faculty; especially, they collaborate with the southern station with a rational division of tasks. They have also had collaboration with international colleagues through several EU projects.

The UoA has raised considerable grants for research projects. The unit has obtained some important scientific results during the assessment period, largely related to the basic research on plant-nitrogen relations. The results have been published in highly esteemed scientific journals, and have led to patents and commercially available products.

The UoA is responsible for a major part of the forestry teaching in SLU, including about two doctoral dissertations per year since 1998.

The UoA's activities in FOMA have high relevance and are promising.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The work of the UoA has a sound scientific quality. Some important scientific results have been achieved during the assessment period, largely related to the basic research on plant-nitrogen relations. Especially, the discovery that plants take up amino acids directly has been path breaking both scientifically and practically, demonstrating how the link between basic science and applications may promote innovation. Other interesting results include the role of charcoal in forest soil, artificial dispersal of epiphytic lichens to promote species

conservation, and the analysis of the lateral spread of root systems. The UoA as a whole demonstrates originality of ideas and innovation, and has been able to utilize the synergies created by the large department, especially, by the interaction between basic research and applications. They focus their research on their own areas of competence, while seeking collaboration to complement their work in fields not covered by the department. This strategy of clear focus with relevant collaboration is useful for productivity and quality.

The UoA has taken part in international teams of high scientific quality, e.g., to publish review articles. Their papers have often been published in highly esteemed scientific journals. Several members of the unit have a high rate of publication, although this is not true of all. In any case, the average scientific productivity of the whole unit is of a reasonable standard. Their goal is to double the rate of publication.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The innovation in scientific results shows that the UoA is capable of scientific leadership. Its work has also been recognised at least in Europe, judging by the several EU projects it has been part of, as well as international invitations as speaker and examiner of dissertations. The recent publications in highly respected journals will improve the recognition of the UoA and shows that they have been able to lead the scientific discussion at least in certain areas. Nationally, their impact on the scientific debate is very high, and they offer a very attractive environment to PhD students and other researchers. This will be emphasized by the new and ambitious Future Forest program, which they help design and are leading. The unit does comment that its interaction with the society outside the forest sector has been weak, but one of its strategic goals is to become the most important scientific partner for stakeholders such as the forest industry, forest owners, NGOs and society in general in questions on sustainable forest management. There could even be merit in coordinating departmental/faculty initiative to lead the scientific debate on sustainable forest management, but this may be difficult because even within a department there will surely be varying view points. This could be something to consider though, to lift the public profile of the UoA, department, faculty and university.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA has been active in supporting forest management through interaction with stakeholders. They participate in theme research projects in cooperation with the industry and stakeholders, and they provide growth and yield models for practical applications: e.g., in cooperation with Skogforsk, and the HEUREKA system which will have wide practical

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

application. They have been proactive in producing educational material, and are educating PhD students in a research school for silviculture. They have also produced patents on applicable scientific results and actual products (nursery fertilizers) on the market.

Regional, national and international, and immediate to long term:

The research has a regional and national perspective especially in the applied fields of silviculture, and growth and yield that rely on the national field measurements and experiments. Especially important is that these results can have significance throughout the boreal region, thus an international dimension. The studies of the causal relationships and their interpretation in terms of applications have a global scope. This is immediately demonstrated by the research on tropical silviculture done by this UoA. The unit has been successful in studying similar questions both in the boreal forest and in the tropics. The UoA has immediate, short-term impacts on society through their contacts and discussions with stakeholders on timely management issues, their contribution to projects such as HEUREKA provides strong impact in the medium term, while the impact from the basic scientific research is often long-term or at least medium term.

On the basis of this evaluation, award a score from 1-6 ³:

5

4. Strategy and Potential

The UoA consists of five competence areas, including forest regeneration, growth and yield, silviculture, tropical forestry and ecophysiology. The Department of Forest Ecology and Management, which the UoA is part of, was recently formed by merging three different departments and through new recruitment. The faculty promoted such a merger in order to build new links between applied empirical research, and basic research focusing on processes and causal relationships.

The UoA expresses its strategy as to find and develop synergies between the researchers and the competence areas within and outside the new department. They point out several tools in terms of research projects and theme areas where this goal can be promoted. They also pay attention to the working atmosphere and scientific discussion within the group. Their goals are: 1) to become one of the most dynamic and productive research environments within the field "*Management of Boreal Forests*"; 2) to become a well recognized centre within the area "*Management of Tropical Forests*"; and 3) to become the most important scientific partner for stakeholders such as the forest industry, forest owners, NGOs and other societal bodies in questions on sustainable forest management.

The panel feels that the UoA has formulated its strategy realistically and with insight. The new structure of the department is a great opportunity to improve the links between applied and basic research, and thus to improve the scientific quality and productivity of the department. The UoA has to work to ensure that the new links and collaboration within the department are really formed, and that the merger does not remain a formality. However, they have already demonstrated a good start in that direction and the new department, with the related research schools, provides a critical mass for becoming a world leader. The UoA is not adverse and has been successful in seeking collaboration with other units within SLU and at other universities to

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

help fill expertise gaps in their research projects.

The UoA also has established good collaboration with relevant partners from other universities, the faculty, and the department. They have access to data sources and field experiments. They recognise the need to integrate the human dimension, especially regarding tropical forestry, through external collaboration. They will lead and contribute to the Future Forest program, which is a good opportunity to further improve their scientific quality and productivity.

On the basis of this evaluation, award a score from 1-6 ⁴:

5

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Within the area of FOMA the unit has developed methods related to monitoring of fungi damage. A risk model for the disease outbreak of *Gremmeniella abietina* has been developed and will be used in FOMA to calculate the “Gremmeniella risk index”. The unit has also participated in a project that has developed methods for monitoring forest damage. This work has resulted in one article in the Can. J. For. Res. Annual monitoring of *Cronartium flaccidum* has already started and the results are promising. The work being done is of high relevance because diseases are expected to increase in the future due to global climate change.

B 4. Actions for development at the Unit of Assessment

This unit shows good potential. However, the UoA should more precisely identify its priority projects for the next five years. The unit has a high teaching load when compared with many others at SLU. More professors/researchers, post docs and PhD students need to be involved in teaching to distribute the teaching load and to develop a fruitful interaction between research and education.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 260_1 Forest Planning North

B 1. General assessment of the Unit of Assessment

The research at the UoA focuses on the development of decision support systems for forest management planning at variable temporal and spatial scales, and is directed towards a variety of users. Their main focus is in long-term strategic planning using optimization methods. Their strongest scientific ambition is in the development of new optimization methods and techniques for multi-objective management, including participatory methods and decision-making under risk in a stochastic environment. However, these goals are not fully apparent in the research productivity to-date. The key output recently has been the HEUREKA decision support system, which has been developed during and after the assessment period under the leadership of the UoA. The key scientific papers concern forest fragmentation, management of growth and carbon sequestration, and a theoretical framework for management under uncertainty.

The group is relatively small; however, they work in an inspiring environment that provides synergy by combining different interrelated aspects (inventory, remote sensing, forest growth studies and management). They also have networking contacts with groups in other countries, e.g. an optimization group in France, and they have been included in EU programs and COST actions.

This group concentrates on method development and has not participated in FOMA. However, they expect to include the maintenance and running of the HEUREKA system in FOMA when it is finalized.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

The work done in this UoA can be divided into: 1) method development; 2) method implementation in operational models; and 3) applications to relevant scientific questions in forestry. The method development is where the scientific ambition of the group is focused, but some of the applications have produced interesting new results (e.g. the analysis of forest fragmentation). The development of operational DSS systems is very significant from the stakeholders' point of view, and the development of the new HEUREKA system led by this unit is a very large undertaking with many potential applications. However, its usability is dependent not only on the optimization methods developed, but also significantly on the growth models and other parts used by the system. These have not been the responsibility of this UoA. The UoA concentrated mainly on the development of the framework/platform for HEUREKA.

The general impression of the scientific quality of this UoA is that they are both efficient and

skillful in DSS development, where their key contribution has been to implement multi-objective optimization into an operational system. They have also been actively networking internationally in this field. The technical quality of their work is excellent, and they list the development and implementation of several new methods as their key achievements (especially large spatial planning and large risk problems). However, there is little novelty in the actual conceptual framework used; multi-objective optimization, participatory methods and risk assessment have been recognized as important tools towards sustainable forest management in many research groups in this field. Furthermore, despite emphasizing long-term management goals in their self-assessment, they make no reference to the challenges on DSS created by expected long-term impacts of global change on forest growth.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA has been involved in many European projects and in some as the leader. Their recognition is evidenced by the many international invitations as keynote speakers, evaluators, etc. They also have active exchange of researchers with foreign institutions. However, their rate of publication in peer-reviewed journals is relatively low (25 in 1998-2008 and 15 in the last 5 years).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The work of this UoA on the HEUREKA system will potentially have a large impact on both research and stakeholders. There is already evidence that the system can be used as a workbench for different types of studies including spatial aspects, large data sets and planning forest management at different scales.

Relying on national forest inventory data, the HEUREKA system is specifically Swedish. The activities of the UoA in European research groups will promote wider application of the methods developed by the UoA, especially, those for Decision Support Systems for forest management.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA's strategy is to continue the line of research that they have conducted up to now. This includes the development of: 1) methodologies for long term planning in forestry, including spatial aspects; 2) participatory planning and multiple objective analysis; 3)

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

methods for optimization of problems involving risk; 4) the quality of inventory data; and 5) the understanding of the corporate planning process. Since the UoA has already demonstrated its abilities in these areas, they are feasible to cover, provided that sufficient staff and funding are available. However, these objectives relate more to a service centre than to a research unit at the scientific forefront in their area. No clear strategy towards scientifically more ambitious future directions was specified.

On the other hand, the possibilities of the group to make a stronger impact are opening up, as the staff will have a better chance to focus on research in the future. Until now, its research activities have been hampered by administrative duties and strong involvement in the HEUREKA development program. The situation is now more favourable for a stronger research output with improved quality and greater impact. This will require that the members of the UoA focus more on developing original scientific ideas and the formulation of a feasible strategy towards achieving the goals. Some novel innovation could be developed through combining the strong methodological and technical experience of this UoA, with the human-geo-biospheric system approach of the Forest Planning (south) unit (e.g., as regards participatory methods).

Increasing the impact of the UoA can be promoted by an increased number of PhD students and post docs, a process that has already started. That would result in a critical mass of researchers for the area. In recruitment, they need to pay attention to gender balance, which is strongly male dominated in the senior research group.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not directly involved in FOMA.

B 4. Actions for development at the Unit of Assessment

Up to now, the UoA has been developing the DSS methods using a fairly limited set of underlying models of the bio-physical processes. The results of the optimization are dependent on the models used as constraints, and there is evidence from previous optimization studies that the type of models may also affect the optimization methods that are adequate for the analysis. For example, the degree of detail of the model outputs and the description of dynamic changes in growing conditions (such as under global change) may have an impact. It is therefore recommended that the UoA consider the use of a range of models in the system, which is also a way of widening the scope of their international cooperation. Modelling fungi and insect damage in the climate change context, together with entomologists and forest pathologists, could be a future opportunity.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 260_2. Forest Operations and Techniques

B 1. General assessment of the Unit of Assessment

It appears that the UoA is in a phase of transition and is developing and refocusing its research agenda. There have been many organizational and functional changes in the recent past that may have led to this. The current association of this UoA with the Forest Planning UoA's appears to be a good fit and should lead to some novel collaborative research. A review of the research papers published reveals a very diverse range of topics being researched. On the other hand, this also shows the wide range of topics that fall under the broad category of forest operations. With the current resources available, clear niche areas need to be identified and focused on to develop very high level scientific research that can be easily published in high level international journals. The UoA appears to have focused on wood biomass procurement for bio-energy as one such area. Research on the automation and robotized forest harvesting operations will require excellent collaboration with equipment manufacturers and other groups specializing in mechanical and electrical engineering, as well as robotics and scanning technologies. Research collaboration is being developed with Skogforsk and this should also enhance the research capacity and productivity of the unit. The UoA is highly involved in teaching at the undergraduate and master's level. The development and implementation of the Technology PhD School is an excellent way to increase the number of PhD students, and research and publishing productivity through the projects they will be working on. Also, master's students need to be encouraged and motivated to publish their thesis results. A clear research gap is in the mechanization and optimization of silvicultural operations (e.g., seedling distribution logistics, site preparation and planting, cleaning and pre-commercial thinning).

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA has had some novel research published recently in high quality journals (e.g., biomass versus nutrient removals published in the Canadian Journal of Forest Research, slash reinforcement of strip roads in Forest Ecology and Management). There also appears to be the building of capacity in regard to the procurement and quality of wood biomass for bio-energy production. This area will become more important as wood for bio-energy use increases, due to the very complex nature of the supply chain and the very variable nature of the thermal value of the raw material. The unit also has novel ideas about the concept of automated and robotized equipment for forest operations. Overall, however, the research

productivity has been modest, but there is clear indication that it is increasing. A clear prioritization of niche research areas will greatly assist in developing high quality research that will be easily publishable in high quality international journals. The number of researchers working in the field of forest technology and forest operations is quite small worldwide, the largest group probably being FPInnovations FERIC Division. The UoA's research agenda could be strengthened by networking internationally, to develop strong research teams focused on some priority research and development areas in this field. Some strategically placed financial resources to strengthen this unit could have a major impact on increasing the unit's research quality, impact and relevance.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

No evidence was given in regard to the UoA's ability to lead the scientific debate in its field nor on how it has interacted on the broader scale with society. The unit does have interaction with the traditional forest industry, developing bio-energy sector and equipment manufacturers. As research productivity and quality increase it is assumed that this interaction will be strengthened and enhanced.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

There is great potential on generating knowledge for sustainable forest management since forest operations can cause considerable environmental stress and damage. Research to mitigate any negative effects and on improving operating procedures to minimize environmental and human impacts, biomass removal effects, etc., contribute to knowledge for sustainable forest management. Forest roads are the major source of environmental impact and the UofA has indicated this as an area of research focus. Having cost efficient wood procurement operations for both the traditional forest products sector, and emerging bio-energy and bio-refining sectors is imperative for a sustainable industry.

The research in this field has both short-term and long-term dimensions, as well as can be applicable from the regional to global scale. The concept of continuous cover forestry, and methods and technologies to deliver this concept is applicable to the entire circumpolar boreal forest.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The UoA has identified the following areas as the most promising future research directions: 1) techniques and methods for biomass procurement for bio-energy; 2) automation and robotized forest operations; 3) minimizing environment impacts of forest operations; and 4) new techniques in forest road construction (minimize cost and environmental impact). These are all excellent niche areas to concentrate on, however in regard to automation and robotics, collaboration with the equipment manufacturing and research organizations in mechanical and electrical engineering, as well as robotics and scanning technologies is essential. A gap noticed by the review panel was in the mechanization and optimization of the silvicultural components of forest operations, such as seedling distribution logistics, site preparation and plant, and stand tending. For example, a research group led by Prof./Dr. Pertti Harstela in Finland has focused on this very important area. However, this would require additional resources, as the resources of the current unit are stretched.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

There is only minor involvement of the UofA with FOMA (0.15 FTE of 10.92 FTE).

B 4. Actions for development at the Unit of Assessment

The UoA has identified four strategic niche areas to develop. These are all important areas and there is excellent potential. The automation and robotics area is the most challenging given the resources of the unit. Developing better links and networks with forest operations researchers internationally can be a way to strengthen the research capacity. This would require someone to take the initiative and commit the resources required though. Some strategically placed financial resources to strengthen this unit could have a major impact on increasing the unit's research quality, impact and relevance.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 260_3. Remote Sensing

B 1. General assessment of the Unit of Assessment

The unit prepared a comprehensive self-assessment. Three researchers presented specific research findings, and ongoing and future activities. The unit has grown to a considerable size and two of the senior researchers are now in responsible management positions. The unit engages in a broad field of remote sensing technology and applications, and is in some fields recognized as among the globally leading research groups, in particular in airborne Lidar for forestry applications. The unit has been successful in raising large competitive research funds.

Remote Sensing serves also as a data and map provider for other projects and applications. Through this role, the UoA supports FOMA activities such as the national forest inventory (NFI) and the landscape inventory (NILS). An impressive collaboration product in that context is the regionalized forest map of Sweden. The group is partner in several larger international projects. Two engineering companies have emerged from the unit as spin-off's.

The team benefits much from collaborations and funding from the Swedish Defence Agency and collaboration with Chalmers University of Technology. Altogether, the unit presents a dynamic research team that has achieved to build a clear corporate identity and internationally recognized research profile. The demand for remotely sensed products for national and global scenario analysis research will continue to rapidly increase, and it will be a major challenge for the group to define priorities and keep pace with the rapid development. So far, they have managed this excellently and maintain their clear profile.

In terms of publications, the unit has had an excellent presence at international conferences and a good record of scientific publications. The UoA is aware that they should focus more on publishing peer-reviewed articles in high impact journals rather than publish a lot of conference papers, and indicated they will be moving in this direction. The panel feels that with this change the UoA, in the future, will have an excellent scientific publishing record and will be at the cutting edge of international research in its field.

Among the major issues is the demand for highly specialized and skilled researchers who are difficult to find and difficult to attract, given the salary system at SLU.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research in this unit is driven by the technological developments in the field, by own ideas and curiosity, by requests from other research groups, and by FOMA activities. In the

fields in which this unit is working, they are innovative developers and problem solvers, contributing considerable to global scientific progress. This is particularly true for airborne laser scanning, but also for 3D-visualization and radar remote sensing.

There are not many remote sensing research groups in the world that cover this broad range of topics with the same depth and intensity.

The research environment at SLU and Umeå appears very appropriate and beneficial, in particular the proximity to the NFI and the NILS teams. This UoA is well recognized within the SLU and is approached by various SLU units, leading to numerous research co-operations.

The UoA is very successful in attracting competitive third party funding for own and collaborative projects with partners in Sweden and internationally, which are the basis for extensive national and international collaborations. Academic co-operations are intensive, networking is excellent, and the unit is integrated into most of the globally relevant remote sensing research and “global map production” networks. However, given the research field and the size of the group and the limited teaching responsibilities, the number of PhDs is very low, with only four in the past 10 years.

The unit is not much engaged in teaching, though; just one course in remote sensing and some more in GIS. That means that the group has very much the character of a research unit.

The output of peer-reviewed publications appears the second weaker point (assuming that the lists provided are reliable), and given the fact that the UoA is in some fields at the leading edge of research, one might expect a greater number of publications. With relatively little teaching and 11 staff dedicated primarily to research (partly FOMA, of course), the output of 42 papers in 4 years (only 13 with the first author from the UoA) can certainly be improved upon. The UoA has explicitly recognized this.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The UoA is efficiently organized into thematic groups and maintains an excellent and motivating working environment for the researchers. Integration of more PhD research would be beneficial.

Within the global remote sensing research community, the unit has a very good reputation and they are certainly among the leading contributors to the scientific debate in some fields of remote sensing technology and applied remote sensing, including laser scanning for forest attributes, radar for biomass assessment and national level regionalization by linking field data and remotely sensed data.

The UoA is represented in numerous international commissions and some awards and fellowships have been granted. The UoA maintains various excellent collaborations on national and international levels, participates in scientific exchange as sending and receiving

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

institution. The UoA is excellently represented at international conferences, frequently with invited papers and as keynoters.

Altogether, the UoA has a strong influence in the scientific debate in various fields of remote sensing and has an excellent international reputation.

On the basis of this evaluation, award a score from 1-6 ²:

6

3. Relevance and Impact

The unit is active in research and development: 1) on a technological level (participation in preparing an ESA biomass radar mission); 2) on an implementation level (support to and collaboration with NFI and NILS); and 3) on an analysis/algorithm level (visualization, individual tree identification, etc.).

The field of “remote sensing” itself is per se a typical field whose expertise is demanded in practically all applications that require spatially explicit information. The group is utilizing this position in a proactive and efficient manner and is currently playing an important role both in research and in FOMA. The UoA is expected to maintain and expand this role because the demand for remote sensing products in both large area research activities and policy processes is growing.

Also the Swedish forest industry appears to be gradually more interested in this technology. Two spin-off companies have been founded out of the unit, pointing to the immediate practical relevance of the development work being done. The unit has been for a long time a partner in research and development to the Swedish Defence Agency.

Altogether, the unit employs its expertise and networking efficiently in such a way that national and international relevance, impact and visibility are excellent to outstanding.

FOMA activities and regionalization are at the national level. Methodological developments do not have a geographical scope. The UoA contributes also to global initiatives.

On the basis of this evaluation, award a score from 1-6 ³:

6

4. Strategy and Potential

Despite the concerns on funding and skilled personnel as expressed in the self assessment, the unit has managed very well to cope with the challenges of this rapidly developing research domain and to build and maintain a clear research profile. This can be taken as an indication that the unit's management strategy is excellent. Young researchers are both recruited from forestry and from physics/engineering. More involvement in teaching in specific remote sensing topics may attract the interest of more young researchers. The remote sensing image processing equipment is up-to-date and excellent, and one of the foundations for successful

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

research and project implementation and collaboration.

To cope with the increasing demand for remote sensing products and involvement in environmental research, and for development of algorithms, the groups strives to generate two new professor's posts: one for remote sensing of environment, and one to strengthen statistical and methodological developments of remote sensing image processing. One may wonder whether this expertise can also be brought in from other SLU units. However, if the UoA strives to strengthen even more the international visibility in the broader field of application of remote sensing to national and international processes regarding natural resources, these two posts will most likely cause a significant push towards that goal.

While the impression of the panel is that there are good links within SLU at various levels, as well as outside the SLU in Sweden, the unit itself wishes to further develop and optimize these links.

Given the past performance, the dynamics of the team, and the diverse successful project collaborations, this UoA has the potential to become even more influential in remote sensing research and application. The two main negative points identified have been recognized by the unit in this KoN process, and it is expected the unit will address them in the near future: i.e., more involvement and integration of PhD students, and more publications in scientific journals.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The unit supports various FOMA projects with remote sensing products, where they also focus their research on efficiently making available large area data sets for environmental monitoring.

B 4. Actions for development at the Unit of Assessment

The unit is internationally very well positioned with a clear profile and clear definition of goals. While the unit complains about the challenge to find skilled young researchers, they obviously managed so far to meet that challenge.

Strengthening the unit by two professors, one in environmental applications and one in statistical methods is an option that would considerably strengthens the UoA's capacity to maintain their leading role in forestry applications of remote sensing, and would open a better path towards a similar position in environmental applications as well.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 260_4. Swedish National Forest Inventory

B 1. General assessment of the Unit of Assessment

This UoA is explicitly not a unit that is geared towards research, but to the implementation of one specific FOMA activity, the National Forest Inventory. Its major service is to support national policy formulation and related issues, and increasingly to give input to the national reporting for international processes (e.g., FAO, EU, UNEP). However, there are also links to research in two ways: 1) providing data for policy development (in particular long time series on the development of Swedish forests); and 2) as an important data source for research and education. As a data source for research it is being used to a varying extent by SLU researchers and researchers from other universities. A particularly close collaboration exists with the SLU Remote Sensing Unit, who use NFI data for verification and ground truthing. Various publications have resulted from these collaborations. In addition the Swedish forest map, based on kNN input, is a prominent joint product.

Research questions are worked on together with other research groups, in particular when it comes to make the NFI more cost efficient; collaboration with the Forest Inventory Unit and the Remote Sensing Unit are most prominent in that context. However, the scope for optimization of the NFI methodology is limited because the consistency of the long-term time series that had been produced so far must not be compromised.

Given the specific tasks the unit has no professor and is comprised primarily of data analysts. While the unit is efficiently implementing the ongoing NFI work, it is in an unsatisfactory situation where the post of Chairman of the NFI board is not currently occupied and thus potential upcoming strategic issues may not be efficiently dealt with.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Research is not at the centre of the unit's responsibilities, but it does support research of other units through data provision. In that, they are contributing high quality data to the research community and members of the UoA do co-author scientific publications. The publication record is not bad and two papers have members of the NFI team as primary authors. This unit does not compete for research funds nor does it have a specific research agenda or profile. This panel, therefore, cannot score the UoA's past performance regarding scientific quality.

On the basis of this evaluation, award a score from 1-6 ¹: NA

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

As the Swedish NFI is an implementation unit, there is no scientific debate whatsoever. In further developing the NFI in terms of methodology and efficiency the UoA is certainly recognized as an important player. But altogether, this panel cannot rate this UoA regarding recognition and leadership.

On the basis of this evaluation, award a score from 1-6 ²: NA

3. Relevance and Impact

The unit produces primarily data and information – and not knowledge. However, in providing data and information, the unit is efficient and contributing to national policy formulation. The Swedish NFI is recognized as one of the world leading NFIs in terms of methodology and implementation efficiency. This, however, is a “research product” of the collaboration with various units (e.g., Forest Inventory, Remote Sensing, Statistics).

While relevance and impact of the Swedish NFI and its team is for FOMA and related processes, this panel cannot rate this unit.

The Swedish NFI produces information for Sweden and for national reporting. The Swedish NFI planning and implementation strategy is a blueprint for many other inventories worldwide.

On the basis of this evaluation, award a score from 1-6 ³: NA

4. Strategy and Potential

The strategy in this case is to have the NFI as a “production unit” (which does not have its own research agenda) within a university environment. The close proximity to and immediate interaction with research units is an advantage, bringing considerable benefits to both sides. The potential competition for funds within SLU may be critical if the unit were to have a research agenda.

The potential of the UoA is such that in the future the implementation of the NFI is guaranteed. However, the strategic directions and goals for the NFI will not be defined within this assessment, but by the management Board. This panel, therefore, does not see a possibility to rate this UoA regarding strategy and potential.

On the basis of this evaluation, award a score from 1-6 ⁴: NA

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The Swedish NFI is a FOMA project. It is efficiently organized and internationally recognized as a modern, efficient and comprehensive national forest inventory in terms of planning, implementation and reporting.

The close links to the related research groups at SLU facilitates facilitate further development of the NFI strategy and adaptation to the ever-increasing data demands from various user groups. The unit supports the development of new NFI strategies and research activities (like the nationwide Lidar campaign) and the implementation of the new comprehensive information system HEUREKA.

B 4. Actions for development at the Unit of Assessment

The UoA has a clearly defined mandate, which they fulfil in an up-to-date and efficient manner.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 260_5. Forest Inventory

B 1. General assessment of the Unit of Assessment

The self-assessment is excellent and a good basis for the panel to assess the UoA.

The FTE use of staff for research, FOMA and teaching as reported in the assessment do not add up to 100% but it was estimated that the unit devotes its FTEs to ~50 % research, ~25% FOMA, 5% teaching and the remaining ~20 % to activities such as administration. The unit is well functioning in both research and FOMA. The goals and strategies are clear, relevant and realistic. However, the publication activities could have been more intensive and the number of PhD students higher. The panel has only one proposal for action, namely to explore broadening the geographical scope of the research part.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The panel is of the opinion that the work to make historical data on forest resources available for future research is valuable. However, this activity should be considered as FOMA and not as research. However, the panel is aware that the classification might have been influenced by for us unknown and relevant factors: e.g., the possibility to get funding.

The research is mainly demand driven. The demand originates from practical forestry and from FOMA within SLU. The UoA also functions as consultants to forest companies, Swedish Forest Agency, other authorities and FOMA on mainly inventory methodology issues.

The choice of methods seems to be appropriate and the scientific productivity high. The panel believes that the UoA is somewhat below the best in the world. As the research is demand driven the geographic scope is mainly Sweden. The UoA participates in several international networks and also in national and international research projects. To some extent it has been among the initiators of such activities.

The publication list shows that the UoA, when appropriate, seeks cooperation with researchers outside the unit, both within the same department and outside it.

The number of PhD students is lower than desirable and during the period 2004-2008 only one presented a dissertation according to the self-assessment.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The balance of the staff with regard to competence, and also to age and gender distribution is good. The efforts made at the department level to provide an attractive research environment are praiseworthy. The unit is well recognised within the academic community, in the forest sector and to a large extent also within the overall society perspective. The invitations as speaker in international and national scientific conferences are numerous.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Up until now the unit has delivered results that are applied in practical forestry and different FOMA activities. The potential to generate more such results is judged to be high, even if it is sometimes difficult to have enough competence over the whole field with the present staff compliment.

The present geographical scope of the research is Sweden as mentioned above. The potential of the unit to satisfy further demands is high. Therefore, the panel believes that this scope could be broadened to the international level if further funding is made available. For example, there is a great need for increased knowledge, efficient forest inventory design and methods in developing countries. Perhaps the approach of UoA 330_3 Tropical Silviculture could serve as a model to some extent.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The panel finds the presented strategy clear, relevant and realistic. It could have been more ambitious. For example, the potential to broaden the geographical scope to the international level should be explored. One provision for this is more funds.

On the basis of this evaluation, award a score from 1-6 ⁴:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Quality. See B 2.

Recognition and leadership. See B 2.

Relevance and impact. The unit has delivered what is demanded with high quality.

Strategy and potential. The presented strategy is well balanced. The panel only wishes to emphasize the importance of the EU collaboration.

B 4. Actions for development at the Unit of Assessment

Carry out a careful exploration of the possibility to expand the geographical scope to the international level.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 295_1, Silviculture, Forest Growth and Yield

B 1. General assessment of the Unit of Assessment

The self assessment report failed to portray the full activity and impact of the UoA, and seems somewhat heterogeneous as presented. As a consequence the panel had to base its conclusions on the new information provided during the interview as much as on the self-assessment report. There are two major components.

A sub-national (regional) component, which emphasised the use of field experiments to study and improve the management of conifer and broadleaf forests in southern Sweden. The first component has had a sub-national (regional) impact fulfilling its mission of contributing to improve the management of southern Swedish forests. The amount of time and resources devoted to outreach activities may reflect this reality and must be relevant to local stakeholders.

The other component was added ca. 2002 and derives its scientific impact from long term manipulation of field experiments aimed at the study of the impact of forest management, growth agents (i.e., CO₂, water, nutrients and temperature) and climate change on forest ecosystem processes. As an example, the Flakaliden optimised growth experiment (installed 1991) generated very important scientific (ecological) information as well as a great deal of national and international collaboration. In both cases there is a meaningful collaboration with UoA 241_1 Forest Management (Umea).

The group, as a whole, has a very good peer-reviewed publication record and a great deal of internationalization. The challenge will be to maintain these levels of achievement in a creative manner.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA achieved high scientific quality due to the originality and creative implementation of: 1) The full use of field experimental plots to develop and improve silviculture in southern Sweden where relatively small property ownership predominates in contrast with the large corporate land holdings in other regions; 2) long-term manipulation experiments (optimization of growth). In this case, the concepts behind the experimentation developed from the Swedish “school” of tree nutrition and the choice of methods proved to be adequate when the design and approach were “exported” to different parts of the world. The professor involved in this work achieved a great deal of internationalization and prominence. This resulted not only from the excellence of the ideas, but also from the effort to create and maintain long-term ecological research sites (e.g., Flakaliden, in collaboration with UoA

241_1 Forest Management). It is worth stressing that such installations may prove invaluable in future forest research and may have a synergistic effect on research by attracting researchers of different capabilities and scientific areas and thus leading to innovative approaches. In general, the scientific productivity is very good in terms of quantity and quality. In terms of scientific achievements there were recognised contributions to the better understanding of the effects of climate change on boreal coniferous forests. Locally the UoA contributes to improving the management of production forests in southern Sweden.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The international dimension of some of leading members of the UoA shows clearly their ability to lead the scientific debate and to create an attractive research environment. Furthermore, the theoretical basis of growth optimization developed in Sweden after the 1960's and this UoA became known in this area. Nevertheless the group, consisting of 10 senior scientists (professors, associate professors and senior researchers), is on average graduating less than one Ph.D. per senior researcher each 5 years. Although reasonable, this is probably below the potential, and the UoA itself aims to increase this number.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The more traditional part of silvicultural research has been to a large extent demand driven and has satisfied knowledge gaps in southern Sweden since the unit was created ~20 years ago. The unit has been active in extension of research results and in meeting the research needs though giving good recommendations for forest practitioners. The future potential for generating relevant research is good.

As mentioned above, the research of the UoA have both scientific and practical impacts: e.g., 1) the identification of nutrients as a limiting factor in boreal forests; 2) the characterization of soil water availability in the co-limitation of tree growth; and 3) the demonstration of respiration acclimation in ecosystems subjected to long-term exposure to elevated soil temperature, as well as the interaction between nutrition and elevated CO₂. The datasets of these experiments are extremely valuable for model construction or validation. The publication record is very good. The less qualified parameter of the bibliometrical analysis, i.e., publications points per researcher, reflects possibly the large number of co-authors in some synthesis papers.

On a geographical basis the impacts are twofold: 1) global, in the case of the long-term manipulation experiments for the evaluation of the effects of climate change on tree growth and ecosystem processes; and 2) regional (sub-national and Nordic) regarding the contributions for the evaluation and improvement of silviculture and management of Norway spruce, Scots pine and birch forests.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

The niches occupied by this UoA are, on one hand, applied forest research relevant for production forestry at the sub-national level (southern Sweden) and, on the other hand, use of manipulation experiments to test hypotheses and monitor the effects of global change. This approach is not yet fully exploited. The new field facilities/research sites of 3000 ha seem to be a sound initiative that deserves to be pursued. Other examples of local importance (i.e., southern Sweden) are new long-term experiments on young Norway spruce and methods of conversion from conifers to broadleaves, as well as emphasis on wood quality and carbon sequestration. There should be a strategic plan to on how to maintain the degree of scientific quality and internationalization reached by the UoA in the recent past and present.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

The UoA is in transition with a senior scientist close to retirement. The challenge will be to maintain the recent levels of achievement in a creative manner. A new professor in silviculture – forest ecology should be appointed. The UoA should strengthen the areas where it has achieved prominence (e.g., long-term manipulation of field experiments) and exploit the scientific synergies that can be derived from those site(s). Although attracting some collaboration, namely UoA 241-1 Forest Management, the relatively low level of research unit collaboration within the SLU is striking. The field plots, either existing or new, need to be better utilized by different research groups. Formally recognising experiments such as Flakaliden as 'long term ecological research sites' (LTERS) (e.g., ministry of agriculture through proposal from SLU) could be instrumental in promoting collaborations. Strengthening the area of modelling is essential for scientific proficiency and usefulness of the research results. This could be achieved by recruitment of a new researcher or through formal collaboration. At the regional (sub-national) level the topic of silviculture is important and the need for adaptive management is obvious. The social need in southern Sweden and the origin of funds for research call for the maintenance of outreach activities at a reasonable level. Nevertheless, an opening at the international level is encouraged.

B 5. Additional information

Considering the statement that “many of the researchers (...) are heavily involved in teaching”, the partition of time between outreach activities, teaching and research should be reviewed and a balanced partition of the teaching burden between researchers might prove useful.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report Template – Part B

Panel 8. Forest management and products

Unit of Assessment: 295_2 Forest Planning South

B 1. General assessment of the Unit of Assessment

This small UoA focuses on decision support for non-industrial private forest owners in the southern part of Sweden, with strong research activities in this area on the analysis of landscape level forest management as affected by global change, risk and uncertainty. The unit is also involved in international policy-related research in the southern Baltic region. The unit's work focuses on designing and developing different computerized tools to help in decision making, and also in activities focusing on understanding and analyzing the decision making process of private forest owners. Their most innovative results are related to a modeling effort on the risk of wind damage to forest landscapes, the development of which has benefited from European collaboration. The results of this and other studies by the group have been applied to decision making on policy issues at the landscape scale. The unit has so far not shown very high productivity in terms of peer-reviewed published papers, but on-going international collaboration in an EU project and in the Baltic region presents an opportunity to improve the publications score and scientific quality in general.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The group is small but shows innovation in ideas and methods chosen, as well as in their development of links with relevant partners. However, their productivity in terms of scientific peer-reviewed papers has been relatively low during the period considered, they have not published in the top journals of their field, and their citations scores so far have been rather low, as summarized in the bibliographic indicators (e.g., PP/PhD = 0.2).

On the basis of this evaluation, award a score from 1-6 ¹:

4

2. Recognition and Leadership

This UoA is starting to be recognised by other relevant groups in Europe, as shown by their partnership in several EU research projects, international invitations as speaker and PhD

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

examiner, and organised conferences. They are not yet at a stage where they would be leading the scientific debate, rather they are responding to international debate initiated by others.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research of the UoA is very relevant to their target audience, the private non-industrial forest owners in southern Sweden (and elsewhere). The group has been active in interacting with their stakeholders, e.g., in relation to the Gudrun storm in 2005. An important outreach activity is the EuroForester education program. The program is run by the UoA and 40-50 students are admitted annually. This provides a means for disseminating research results to people who will later follow up with them and/or put the results to use in their own countries.

- 1) Short-term: the main impact is local in southern Sweden.
- 2) The impact through the EuroForester program is mainly in the Baltic region and reaches over medium or long term.
- 3) If the EU projects are successful, there is a wider impact in Europe through an exchange of ideas and modeling methods.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA's goal is to continue research on risk management in forestry, with special emphasis on climate change. They will also focus on the dynamics of the human-geo-biospheric system constituted by the forestry sector, and they plan to incorporate the socio-economic system into management planning models and systems. As also pointed out by the UoA, the most promising line with innovation potential is the analysis of the interface between forest modelling and modelling of the owner/manager activities and decision-making. Based on their location and links with stakeholders, this area has high potential for the group. The UoA is also involved in international teams relevant to their research where they can further develop their scientific potential and international leadership.

They UoA is involved in international teams relevant to their research where they can develop their scientific potential and international leadership. However, they also need to tighten their links with the Forest Planning (north) unit within SLU. Some innovation may develop by combining the strong methodological and technical experience of the Umeå planning unit with the human-geo-biospheric system approach of this UoA (e.g., as regards participatory methods).

The UoA has a PhD programme that should be bringing in new forces to strengthen the unit.

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The UoA needs to pay attention to recruitment in terms of gender balance which is strongly male dominated in both senior researchers and PhD students.

On the basis of this evaluation, award a score from 1-6 ⁴:

5

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

B 4. Actions for development at the Unit of Assessment

A potential strength of the UoA is in the originality of its computerized modelling. The approach is quite robust and can be extended to other forest areas and to risks other than wind damage. The difficulty of attracting high quality PhD students limits the development of this unit. This could potential be alleviated through recruitment of graduates from the Euro-Forester program. Collaboration or integration with similar research units within SLU may be another opportunity to create critical mass and synergies.

Although the UoA is involved in international cooperation it should develop its own scientific potential by growing (taking full advantage of its PhD program) and tightening its links with the Forest Planning (north) unit within SLU. It appears that some synergy may develop by combining the strong methodological and technical experience of the Umeå planning unit with the human-geo-biospheric systems approach of this UoA (e.g., as regards participatory methods).

Forest disturbance (e.g., wind, fire, insect, disease damage) and risk assessment are increasing in importance as climate change and global warming impact the frequency and intensity of extreme events. The importance of research in this area will become increasingly relevant in the near future.

The PhD program should be bringing in new resources to strengthen the unit. The UoA needs to pay attention to recruitment in terms of gender balance.

B 5. Additional information

With regard to the research on forest policy see report on UoA 231_4. Forest Policy and Global Forestry.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 8. Forest Management and Products

Unit of Assessment: 330_3. Tropical Silviculture

B 1. General assessment of the Unit of Assessment

This UoA recently moved from the Forest Genetics and Plant Physiology Department to the Southern Swedish Forest Research Center in Alnarp and considers this change beneficial. The self-assessment had a number of gaps that were filled during the interview. With only three staff, this UoA is among the smallest the panel evaluated.

The UoA focuses on specific research topics in developing countries that originate mainly from the scientific background of the head of the unit. Starting from seed quality assessment and related issues, the restoration of degraded lands by establishing tree communities is at the centre of the research, with a clear focus on dry tropical areas. Research is mainly done through PhD projects, contributing at the same time to knowledge generation and to capacity building in the partner countries. The academic education through PhD theses is considered essential; which has probably also to do with the size of the unit. Research topics are defined together with colleagues in the countries. The publication record is quite good and the unit is presenting at various international conferences (contrary to what the empty box in the self assessment suggests). The small size of the unit results in the research being focused on specific topics.

The future strategy of the unit implies that a much wider thematic scope, including the social dimension of forest restoration and climate change adaptation research, will develop. Reinforcement of the research group is mainly through SIDA funds, where its work is well recognized and which is the major funding source for the unit's PhD research.

This whole assessment is done taking in consideration the small size of the unit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The publication record is modest as reflected in the bibliometrical indicators; in only 6 of the journal publications the first author comes from the UoA. Some of the journal publications do not refer to the tropics. Many co-authors come from partner countries pointing to good international collaboration. Project money comes from SIDA.

The topics covered and the methods applied vary and concentrate on research on rehabilitation of degraded dry lands and on descriptive research on forest structure. The strategy is to implement the research exclusively by SIDA resources and through PhD students. This approach, consistent with the size of the unit, is successful. However, the competition in this area for SIDA funds is not as competitive as for funds from national

granting councils. On the average one PhD has graduated annually from the unit over the past 10 years and all are mostly employed in higher education institutions and research institutions in their home countries.

The unit maintains a network of permanent observation plots in Burkina Faso, which is an unusual and advantageous setting. This is expected to be a valuable source of future long-term analyses, and related research and publications.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit is an important research partner for SIDA and is recognized as such. There are no awards or external assignments given in the self-assessment and the interaction with society is limited to developing country interactions, which is in the core of the unit's tasks. Lacking a critical mass, it is difficult for the unit to "lead the scientific debate" even in its field of expertise. However, in the unit's special field of forest restoration the unit is recognized and visible, particularly in the countries where the research is concentrated.

The unit maintains a very good and motivating working environment. PhD students are the backbone in research and external recognition. With six PhD students this unit is far above the average per researcher/professor of the units evaluated by this panel. Most of the graduates return to their countries and act as "disseminators". The unit does also use the platform of international conferences with two invitations as invited speaker and 11 conference proceedings. An important fact in this context is the active academic interchange as shown by the relatively high number of outgoing and incoming researchers.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The major impact of the unit is in those selected developing countries where its activities are and in the thematic fields that the unit can cover. Given the small size and field of specialization of the unit, the impact is narrowly focused, but good, resulting partly from the research outcomes and partly from building academic capacity in research and administration in the partner countries.

PhD graduates have practically all gone back to their home countries and work in institutes of higher learning and research institutions, thus contributing to the general impact. Theses do also constitute an important network for the unit.

Research topics and projects are identified together with stakeholders from the partner

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

countries and are relevant for the country's development: e.g., an example is given of the special seed treatment techniques developed in the unit that are being applied in nurseries.

The unit concentrates research on sites in Nicaragua, Burkina Faso, Laos and Nepal. Students come from other regions though. It certainly makes sense for such a small unit, to have a clear geographical focus and profile, but that should not hinder active dissemination of methodological findings to other countries.

On the basis of this evaluation, award a score from 1-6 ³:

4

4. Strategy and Potential

This UoA is not unique at SLU with respect to their specific international focus on tropical developing countries. In the Department of Forest Ecology and Management there is a working unit on Tropical Forestry. These two groups maintain a good, although obviously not really tight, working relationship, with a partial thematic and geographical overlap. The panel does not see a serious structural issue there, because there appears to be a clear division of labour and specificity of approaches; the UoA does more research in the dry tropics while the Tropical Forestry group is also in the wet tropics. The UoA's research is very much PhD-thesis driven, while the Tropical Forestry group engages in more general research projects and is embedded in a larger forest management research environment. However, the question remains whether it is efficient to have these two units spatially separated.

Potential and interest for collaboration within SLU would also be with the Forest Policy and Global Forestry unit, but that has obviously not materialized yet to a full extent. Cooperation in the field of social forestry by this UoA is mainly with other universities (Uppsala University, Lund University), and lesser so within SLU units. This UoA has expressed that it will integrate the "social dimension" and the "forest-people interface" into its future research. Since this has also been expressed by other UoA's, the SLU should consider exploring possible synergies and opportunities.

Future development of staff of this UoA is planned to be done mainly through SIDA funding, which appears realistic. A second post-doc is currently being sought.

It may be expected that offering workshops and training courses (for alumni and interested professionals) would contribute to strengthening the networks, disseminate findings and identify future research collaborators.

Altogether, the strategic planning is realistic and good and in line with the intended future thematic orientation and the potential to implement the strategy within the limits of a small working group is there.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)*****B 4. Actions for development at the Unit of Assessment**

See 4. Strategy and Potential

This UoA shows good scientific approach and methodology, and clear objectives and potential. However, the small size of the unit may impair its development. The funding could be improved through more SIDA funds and the recruitment of senior researchers seems necessary in regard to the high number of PhD students requiring supervision.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 9. Biosystems technology

Content and strength. The Panel was generally very impressed by the quality of the applied research work and engineering undertaken by the 9 UoA's in Biosystems Technology. The overall arithmetic mean for each of the four categories for each of the units of assessment ranged from 5.3 to 3.0. There was a reasonable distribution over this scale. The stronger UoA's were Biomass Engineering and Technology and Soil and Water Management. Mid-range areas were Technology; Animal Environment and Building Function and Rural Building Design. Bio-energy from Woody Biomass; Farming Systems, including Technology; Landscape Development with a Natural Science/Technical Approach and Climate, Energy and Environmental Technology were collectively the weaker areas.

Those at the upper end of the scale should be considered in the “High international” category and should be cherished by the University and given every opportunity and encouragement to develop their potential further. Similar encouragement should be given to the mid-range group which has many similarities in their attempt to rebuild their direction and align to the “new” research environment. Stronger leadership is needed the help them identify sound research directions. Those in the moderate category would benefit from a positive and sensitive leadership to help them identify and address their problems. In all cases, irrespective of the outcome, the Panel had concern about either:

1. the lack of leadership in the weaker cases, albeit the University has recently appointed a new Professor in Farming Systems including Technology. However, it will take a period of time for the effect of this to be realised or
2. the professorial succession planning for UoA's such as Soil and Water Management where experienced professors approach retirement.

Future potential. With the current renewed international interest in both sustainable food and fibre production and the environment there should be a good future potential for:

1. major research projects, and
2. the training of PhD candidates both domestic and international.

It is essential that Senior Managers maintain the correct lines of communication with the Government, EU funding agencies and industry to ensure that staff members have the best advice with respect to future research programmes. The Panel recommends that a strategic review of the existing technology platforms and other strategic agendas guiding research funds at national and EU levels be conducted by the Senior Managers of SLU.

Synergies, multi- and inter-disciplinary activities. There are many potential synergies and multi- and inter-disciplinary activities between the UoA's and it was felt that a number of the weaker areas have been exposed by possibly subdividing the Faculties/Departments into too many small fragmented Units. These small UoA's whilst not internationally strong in research, can make a considerable contribution to the work of the University. Consideration must be given as to how to formulate the most effective teams which allow the more research active staff to focus on that business, with others helping with the remaining activities of the university such as the production of practical farmer oriented handbooks.

Strategic coordination between the UoA's. The comments above lead to the need for greater coordination between some of the UoA's, such as:

1. linking Bio-energy from Woody Biomass with Biomass Engineering and Technology,
2. linking Climate, Energy and Environmental Technology with Rural Building Design and Animal Environment and Building Function.

3. The work of the Farming Systems, including Technology UoA needs time to develop a research profile following the appointment of the new professor who plans to establish a platform for crop system research. There should be synergy between this UoA and the Technology UoA, which would be better described as Biosystems Engineering.

The range of UoA titles need to be simplified and clarified. We recommended that SLU should organise multi-disciplinary conferences among the different UoA's in order for them to identify greater naturally developing "organic" synergies within this and units in other fields of research.

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 435_2 Soil and Water Management

B 1. General assessment of the Unit of Assessment

Research within the Division of Soil and Water Management focuses on two research areas: soil mechanics and hydropedology and can be characterized as applied and practise oriented. This contributes to the sustainable development of agro-food- environmental continuum.

Research of the unit covers:

- Efficient and environmentally sound tillage systems
- Soil mechanics, soil compaction, soil structure, soil amelioration
- Supplemental irrigation scheduling under semi-humid conditions
- Land drainage with minimum nutrient leaching and gaseous emissions
- Soil construction (for sports areas, vegetation establishment in mining tailings)
- Soil and water management in developing countries.

The UoA has a long tradition of collaboration with developing countries in research and PhD education. The Panel was impressed by the ability of the group to carry out research of wide range of applied agro and environmental sciences also displaying considerable depth. At the same time they demonstrated a large variety of techniques and methods applicable in the agriculture and horticulture sectors. Their work integrates laboratory scale experimentation up to pilot and full scale commercial operations. They have well formulated ideas on how to respond to changing demands of National and EU's agendas.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The panel was very impressed by the quality and versatility of the research. The UoA showed a high degree of originality in developing and applying novel research methods and disseminating their results to the agro-environmental sector. They combine creatively soil science, agricultural engineering and water management providing the sector with highly applicable research based solutions e.g. best practices in tillage and water management. One of their key elements of success has been close cooperation with practice (especially machine and equipment manufacturers) in the sector. The group published in the period of assessment 70 papers overall which are on average 0.49 per researcher being in top three within Biosystems Technology Group. This received 7.27 citations per paper with 5.1 % of the papers in the Top 5% within their sub-field. They are unique in Sweden and have close collaboration with number of Nordic and European institutions and overseas (for instance North Carolina State University). The scientific quality was rated as high international (5.0).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA is well able to lead the scientific debate in their sector offering a high degree of scientific integrity with practical agro-environmental engineering solutions and monitoring programs for soil preparation, water and nutrient management in wide variety of environments ranging from farmland to football fields and former mining areas. It also provides an attractive and stimulating research environment by providing good facilities, very motivated staff and expanding links with other relevant research groups world wide. We are convinced that the UoA is a highly trusted independent source of opinion both in society and industry and we also believe that there is growing demand and opportunities for this to be further developed. The group has been able to identify the driving forces and challenges of European agro-environmental sector showing strategic thinking. However, the human capacity of the UoA has to be guaranteed by filling the pending two professorial vacancies as the current professors plan to retire in the relatively near future.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA displayed an exquisite potential for developing and supporting the economically and ecologically efficient farming and “green” construction by providing viable engineering solutions to the agricultural sector, industry and society. Their research on technological and methodological solutions to mitigate greenhouse gas emissions from cultivated organic soils gives a good example of their strong contribution to sustainable development.

Their work has national and global significance in the medium and longer term. Their results are highly applicable in the boreal zone and group is recognized globally. UoA has successful research in soil and water management in African and South American countries producing many PhD's in the countries.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future potential of the UoA is high because of the skill, drive and enthusiasm of the people involved and the fundamental nature of the research area in food production and environmental sustainability. It would be highly desirable to strengthen the unit, since growing demand of applied research for food security and longevity of farming also taking into account economic and e.g. soil-machine aspects. This assists both the agricultural and “green” construction sectors. Younger potential faculty members are being developed. The UoA works in a very important field providing practical and applicable scientifically proven solutions to meet the EU's renewable energy and FOMA's objectives. Thus Panel has

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

identified that UoA is very prominent in terms of demands of surrounding society and capable to respond to these demands. The gender balance is reasonable considering the skill disciplines required for the subject area.

As stated earlier, UoA demonstrates strategic awareness and has used national and international research agendas and technology platforms in redirecting their research and education.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Among Biosystems Technology section UoA is leading unit within the framework of FOMA including Quality, Recognition, Leadership and Relevance and Impact.

B 4. Actions for development at the Unit of Assessment

The UoA has already developed a strong international network having consolidated their position in both Nordic and European research networks. It is recommended that faculty places the unit at the centre of gravity in its future development. The panel supports UoA's objective to increase its publication rate in international peer-reviewed scientific journals. It is imperative that the role of this unit of assessment contribution to agricultural productivity be maintained.

B 5. Additional information

It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 545_1 Biomass Engineering and Technology

B 1. General assessment of the Unit of Assessment

The research of the group deals with new applications of material science and technology for the pelletization of biomaterials, which is important for the future demands of society in regard of sustainable use of energy. The group develops state of the art technologies for pretreatment, modification, fractionation and densification of forest-based and agro-based biomass as well as residues, waste material and peat in order to produce power, heat, bio-fuels and higher value added products in bio-refineries. The panel was impressed by the ability of the group to carry out research of considerable depth. At the same time they demonstrated a large variety of techniques for production and analysis of compressed biomass (pellets). Their work integrates other scientific disciplines such as analytical chemistry, physics and engineering with future aspirations to incorporate nanotechnology to understand the interfacial mechanisms between biomass and the pelletizing equipment. They have ideas to fluidize small compressed particles to be used for both transport purposes and for the direct injection into gasifiers.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The panel was very impressed by the quality of the research. They showed a high degree of originality in selecting and applying research methods. They produce stable pellets by applying new technologies such as by the regulation of die temperature. They have developed a number of analytical methods based on NIR spectroscopy. One of their key elements of success is their activity working at pilot scale plants. The group published in the period of assessment 66 papers overall which are on average 0.78 per researcher giving the highest output within Biosystems Technology Group. This received 8.54 citations per paper with 10.6 % of the papers in the Top 5% within their sub-field. They are unique in Sweden and have close collaboration with Canada (University of British Columbia) and several research organizations in the Nordic countries. The scientific quality was rated as high international (5.0).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA is well able to lead the scientific debate in the sub-field offering a high degree of scientific integrity with practical engineering solutions both concerning pellet production and combustion. It also provides an attractive research environment by providing good facilities, well motivated staff and expanding links with other relevant research groups both nationally and internationally. We believe that the UoA is a trusted independent source of opinion both in society and industry and we also believe that there is even opportunity for this to be further developed. However, more resources are needed to reach the units full potential.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA displayed a high potential for expanding feedstock supply for energy generation and bio-refining by increasing the possibility to reduce greenhouse gas emissions by replacing fossil fuels with biomass.

The work has national and international significance in the medium and longer term. Thereby it contributes to global sustainability. Their impact is particularly strong in the Nordic countries where they have a good reputation.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future potential of the UoA is high because of the nature of the subject area and the skill, drive and enthusiasm of the people involved. It would be highly desirable to establish an international bio-refinery research school in co-operation with industry and stakeholders. This may help both forest and agricultural sectors. Younger potential faculty members are being developed. In one case a key member of the team is leaving for Canada to expand their experience. It is recommended that resources should be made available to prepare for their return. Presently there is one female (PhD) in the team of 8 researchers, hence there is room to improve the gender balance. The panel believes that there is great potential for improving the synergies between this and other UoA's at SLU.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA has already developed a strong international network. It is recommended that a number of these relationships are given top priority to cement stable long term relationships. It is recommended that some consideration should be given to a modest extension to the teaching role of the staff in order to attract graduates to their area of research.

B 5. Additional information

SLU should encourage exchange of information between research and industry in the bio-refinery area in order to improve the use of forestry products. It is recommended that SLU should organise multi-disciplinary conferences among the different UoA's in order to identify greater synergies with their work.

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 565_1 Bioenergy from woody biomass

B 1. General assessment of the Unit of Assessment

The UoA's research is divided into three main sections: growth and yield studies of broadleaved species and conifers on farmland, characterization and quality management of woody biomass along its supply chain and market studies of (energy) wood and wood products. Topics covered are important for the future demands of society and industry in regard to sustainable supply of biomass for energy. The group uses a traditional approach to growth and yield studies. A more novel topic is the quality management of stumps for energy. In addition, growing markets and trade of woody biomass studies require analyses of market developments. The panel could find only few links between the research activities within the group, but there are connections to other departments of SLU and, for instance, Skogforsk especially in wood quality research. The links within SLU will strengthen as the UoA will be merged with Departments of Soil and Environment and Water and Environment in 2011. The group demonstrated a variety of techniques for production and analysis of energy wood in general and stump biomass in particular.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA showed moderate quality for their research using traditional scientific methods. Long term field experiments of e.g. trees growing on farmland, however, give a solid platform for producing biomass and the growth and yield functions for several tree species. The success of their activity in wood quality and market research is based on good connections with practice and policy makers. Scientific productivity, however, is rather modest. The group published in the period of assessment 39 papers overall which are on average 0.37 per researcher giving the below average output within Biosystems Technology Group. This received 3.82 citations per paper with 1.8 % of the papers in the Top 5% within their sub-field. Parts of their research activity are recognized in Sweden and internationally. The scientific quality was rated as moderate (3.0).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA could take a leading role in the storage and quality issues of woody biomass at the national level. As the new professor starts, the UoA has the ability to also take a leading position in market studies. The main audience and user of the results is the forest and energy industries. The group is somewhat isolated from other fields of forest research due to its geographic location. On the other hand, links to laboratory facilities in the Uppsala campus support the analyses of woody biomass composition and quality among others. We felt that staff motivation could be reinvigorated. It is evident that the UoA is a trusted independent source of opinion both in society and industry, in particular in the field of biomass quality research. The market studies may change the focus and content of the UoA with the appointment of the new professor.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

UoA's work is highly relevant to sustainable development of wood based energy production by e.g. supporting the security and quality of feedstock for energy generation. The outcome of their research should be better communicated to the scientific community and to stakeholders.

The work has national significance in the short and medium term. Currently insufficient resources are reducing its impact. It must be noted that the new professorship in an emerging field of research will give good opportunities for stronger and wider impact in the future.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The group lacks the strategic vision and leadership and would benefit from improved strategic support from the Faculty. The future potential of the UoA can be high because of the subject area. However, the lack of staff's motivation and limited capacity reduce the realisation of the potential in the short term. This has to do with the age structure of the UoA having key members near the retirement age. It is recommended that possibilities for improving the synergies between this and other UoA's at SLU will be examined. For instance, closer organisational link with the Faculty of Forestry and Biomass technology unit in Umeå could support the future development of the UoA.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA has good connections to wood biomass suppliers and users. It is recommended that more focus will be put into publishing the results in the international peer reviewed journals. It is also recommended that the organisational home of the unit be reconsidered.

B 5. Additional information

SLU should encourage exchange of information between research and industry in the biomass sector in order to improve the use of forestry products. It is recommended that SLU should organise multi-disciplinary conferences among the different UoA's in order to identify greater synergies within their work.

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 565_3 Technology

B 1. General assessment of the Unit of Assessment

The research of the group is important for the future demands of society in regard of the sustainable agro-food-environmental continuum. The group studies and develops engineering system solutions for a range of what at first appear to be rather broad and relatively shallow series of disjointed projects, however, further discussion showed:

1. that there were principally 4 areas, as shown listed in (3) below, and
2. a willingness to apply engineering solutions to a wide range of multidisciplinary bio-systems problems. The Panel believes, however, that further thought should be given to attempt to consolidate these.

The Panel was impressed by the ability of the group to carry out research of some considerable depth. Their work integrates with other scientific disciplines such as plant, animal and soil sciences, chemistry, biochemistry, microbiology and physics with a range of engineering disciplines and systems design. There is great potential for further work with other UoA's, which independently and together with each of the 4 areas listed in (3) below strongly relate to meeting the aspirations of FOMA.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The panel was impressed by the quality of the research. They showed a degree of originality in selecting and applying their methods, which is a “systems” based engineering approach to a range of issues facing the agro-food-environmental continuum. The group published in the period of assessment 88 papers overall which are on average 0.53 per researcher giving the second highest output within Biosystems Technology Group. This received 3.96 citations per paper with 7.6 % of the papers in the Top 5% within their sub-field. They are unique working group within Sweden and have close collaboration with a number of other countries. Some aspects of their work are particularly focused on the developing world. The scientific quality of their work was rated as Internationally recognized.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA is able to lead the scientific debate in the sub-field offering a degree of scientific integrity with practical engineering solutions concerning a range of agro-food-environmental issues. It also provides a reasonably attractive research environment by providing good facilities, motivated staff and expanding links with other relevant research groups both nationally and internationally (including the developing world). We believe that the UoA is a trusted independent source of opinion both in society and industry and that there is even greater opportunity for this to be further developed; however, more resources are needed to reach the units full potential.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA displayed significant potential for generating knowledge that will contribute to sustainable development of society in 4 main areas:-

1. Optimisation of nutrient recycling systems,
2. Food chain logistics,
3. Energy from agricultural crops,
4. LCA in aspects of primary food production.

This can be enhanced by using innovative engineering solutions to the issues that result from the conclusions of current studies produced by their and other applied sciences.

The work has national, European and global significance in the medium and longer term. Thereby it contributes to world sustainability. Some aspects of the work which are directed to the less developed world have international significance.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future potential of the UoA is potentially high because of the nature of the subject area and the skill and enthusiasm of the people involved. Food production issues are high on the international agenda once more due to a number of major geopolitical, climate, population growth and dietary change issues. There are unfortunately very few groups left in the world that can deliver post graduate training and research to an international market. Thankfully your group is surviving, but needs help in redeveloping its full potential.

Younger potential faculty members are being developed. Presently there are 7 female PhD students in the team and a further two females in the Faculty. The Panel believes that there is great potential for improving the synergies between this and other UoA at SLU.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The group is involved in a number of projects related to FOMA.

B 4. Actions for development at the Unit of Assessment

The UoA has developed a strong international network both in the developed and developing countries. It is recommended that a number of these are given top priority for cementing stable long term relationships.

Comments were made where benefits could be gained from the development of a greater intellectual collaboration with JTI with whom they share the same building.

We believe that re-naming the UoA as “Biosystems Engineering” (or similar) has much to recommend it, the current name “Technology” is a totally inadequate. This adds the potential strength of the problem solving capability of engineers who in addition to undertaking basic research also attempt to harness the output of other disciplines to design sustainable long term solutions via both design and applied research programmes.

B 5. Additional information

It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

Biosystems Engineering has the potential not only of conducting its own work but being a substantial partner in providing engineering services to a number of other UoA's who are in need of their skills and experience.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 634_1 Farming systems, including Technology

B 1. General assessment of the Unit of Assessment

The group develops more resource efficient farming system with regards to efficient use of plant nutrients, machines and fuels, efficient plant protection and reduced leakage of plant nutrients and pesticides. They also are concentrating on developing plants and systems for energy crop production. The group has carried out research of noticeable depth in spite of the disruption caused by the retirement of two professors and the appointment of a new professor who started work one month ago. The group applies variety of research methods and disciplines combining them into the agro-technology and farming systems. The work by its very nature has breadth to encompass the wide range of disciplines required for the scientific inputs into full farming systems as required by any strong “general” agronomic research group.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The ideas for research projects are usually developed together with industrial stakeholders and public authorities and implemented under their guidance. Most of the results are therefore communicated directly to the industry in seminars and popular science journals. The group published in the period of assessment 30 papers overall which are on average 0.13 per researcher giving a low output which could be explained by the retirement of the leading scientists and not including their publications in the bibliometric record delivered to panel. The new professor starting his employment in March 2009 tabled a publication list comprising 102 refereed papers mostly relevant to the area of research of the UoA.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The recognition of the group is presently rather limited to contacts to industry and to authorities in Southern Sweden. The core of their research deserves higher exploitation. The breeding of willow e.g. using new types of combinations seems to be successful and could be expanded through established collaboration with other groups within SLU. Field studies have contributed to a change in recommendations in the fertilization regime in growing potatoes

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

which have lead to savings for the farmers and the environment. However, the research gives an overall impression of being too diversified and their success could be improved by focusing on some of the central issues within the competence of the group. We believe that the UoA could participate in a fruitful way in the scientific debate in the sub-field in the future when the newly appointed professor has been able to influence the work.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA displayed a potential for developing new ideas in conjunction with stakeholders by improving the production of very different species which could contribute to establishing a more sustainable food production and energy sources.

The work by the UoA is by its geographical position special importance for the southern regions of Sweden but also for regions with similar climate in the medium and longer term by adapting farming systems to support sustainable production.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy for the future research is not clearly developed, although there is a potential for the unit to cooperate within the SLU and with industry. One of the future research directions is the development of more resource effective farming systems where plant nutrients, machines and fuels are more efficiently used. This could also include a better plant protection and less leakage of pesticides. The future potential of the UoA is highly dependent on the skill, drive and enthusiasm of the people involved. The group comprises 14 researches including three women. Panel suggests that UoA elaborates a strategic research agenda for coming 5-10 year period. This can be done as a part of possible faculty level strategic process or in a more limited form independently by the UoA alone.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria –

Not applicable

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The UoA will strengthen its research and international recognition by full integration of the new professor.

B 5. Additional information

SLU should encourage cooperation within SLU and with industry by supporting the further development of the existing platform of crop system research. It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

Report Template – Part B

Panel 9. Biosystems Technology

Unit of Assessment: 635_1 Animal Environment and Building Function

B 1. General assessment of the Unit of Assessment

The UoA applies biology and technology to animal production systems. Their research covers the entire systems for production farm animal products and the management of farm animals. They design and develop techniques for animal housing systems, farm buildings, production systems and animal transport systems with special regard for animal welfare and environmental and economic sustainability. Aspects of animal environment, the working environment, the external environment and the product quality are considered in pig and cattle production systems. Staff members have a range of scientific backgrounds ranging from animal husbandry, engineering and applied economics.

The UoA has a very good cooperation network within the university supporting their own expertise in problem oriented research. The unit has identified its core expertise into a systems approach to the animal production.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA showed good quality of their research. The success of their activity is based good connections with practice. Their scientific productivity is high. The group published in the period of assessment over 180 papers overall which are on average about 14 per researcher giving ranking among top units in the Biosystems Technology Group. The publications (26) that unit reported to the panel through the bibliometrical analyses system did not include ALL publications, but only scientifically highly rated papers were included. Unit has highest normalized journal citation score in biomass systems technology. This received 5.4 citations per paper with 4.9% in the Top 5% within their sub-field being again above average in the biomass systems technology. Their research activities are recognized in Sweden and internationally. The scientific quality was rated as internationally recognized (4.0).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA has a significant national but limited international role in the development of pig and cattle production. It is evident that the UoA is a trusted independent source of opinion and has potential to play leading role also at the international level.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA's work is very relevant to sustainable pig and cattle husbandry and there is increasing demand for research based knowledge to support sustainable farming and agro industry. Production of food taking into account the animal welfare, work safety having high work productivity are topics where panel sees room and demand for research that could fit in the profile of the UoA . The impact of results could be stronger especially to the scientific community.

The work has national significance in the short and medium term. Limited resources and vacant professor post have reduced its impacts to larger forums. With appropriate research profile, however, UoA can take leading position in the field of animal husbandry, since international competition is fairly weak.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The group has elaborated a set of future research topics but needs support in generating a vision for the development of core expertise in the field. More international contacts and larger amount of PhD students are needed to ensure scientific regeneration. The UoA's motivation and drive is good and key members are in a productive phase of their careers. The group demonstrates good and functional cooperation with other groups in the department and also other departments in Biosystems Technology. The Panel encourages the UoA to focus in and further develop its best expertise having the greatest potential for new innovations to create added value to cattle production. This could be the productivity of work and effective use of labour and/or other inputs needed in competitive animal husbandry. As the vacant professor post is filled a strategic research agenda for the group has to be elaborated.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA has connections to practise of animal husbandry and their results are utilized in the sector.

B 5. Additional information

It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 635_2 Rural building design

B 1. General assessment of the Unit of Assessment

Focal research areas of the UoA are durability of building materials, concrete in agriculture, bio-fibres for construction materials, design of lying and walking floor areas in houses for dairy cattle and pigs, agricultural building design and costs, architecture of rural buildings, reuse of agricultural buildings and peri-urban and rural planning and design.

Practical development and related laboratory facilities characterize the UoA's activities. The UoA's cooperates with Lund University using their laboratory facilities to support their work. In addition, they are members of the network of "Development of old and new rural buildings" financed by the Nordic Council of Ministers. The Panel noted that the scientific tradition of the UoA differs markedly from natural sciences being closer those of construction engineering and architectural sciences. Thus, the publication and output profile differs from the other UoA's characterized by demonstration, design and new product development.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

If only publication records are considered, the UoA shows inadequate quality of research. However, unit's testing services and demonstration buildings and their structural solutions serve the building activities of farming and the management of the rural landscapes together with the sustainable use of older buildings. The Panel recommends that the quality of their activity should be evaluated by the practical applicability of its results. The group published in the period of assessment 35 papers overall which are on average 3.9 per researcher giving a ranking amongst the lowest units in the Biosystems Technology Group. They received 1 citation per paper with no papers in the Top 5% within their sub-field being again below average in the biomass systems technology. Their research activities are recognized in Sweden and in Nordic countries. Unfortunately, the scientific quality was rated as inadequate (2.0).

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA has a national and a Nordic role in the development of buildings, building systems and materials for animal production. It is evident that the UoA is a trusted independent source of opinion and has potential to play a leading role at the international level. This calls for strong increase in the international scientific publishing.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA's work is highly relevant to society and in particular to rural environments including landscape architecture, animal welfare and agricultural economics. The most important outlet of their contribution is the Systems Solution Handbook series that has been widely adopted by the sector.

The work has national and Nordic significance in both the short and long term.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The current core expertise of UoA is in the selection of building materials, especially in the development of soft floors for horses, cattle and pigs. In this area they are possibly the leading group in the Nordic countries. The UoA has a vision of the future trends in the change of agricultural buildings towards more industrial scale production level, and how the problems of integrating them into the rural and peri-urban surroundings could be solved. They can also identify their role in research and development to meet the demands of this identified change. They incorporate research topics related with bio-based economy and wider use of renewable construction materials and structures in agriculture. The unit recruited new PhD students four years ago and their production of scientific papers is started last year and is increasing. The human capacity of the UoA has to be guaranteed by filling the pending professorial vacancy as the current professor plan to retire.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA has demonstrated strong connections to practise and has apparently strong impact in practises in rural building design. Panel encourages the UoA to publish more in the peer reviewed scientific journals to have higher scientific impact.

B 5. Additional information

It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

Part B: Report on individual Unit of Assessment

Panel 9. Biosystems Technology

Unit of Assessment: 635_3 Climate, Energy and Environmental Technology

B 1. General assessment of the Unit of Assessment

The UoA's conducts research about climate requirements, "air conditioning" techniques and environmental influences from air pollutants in different animal and greenhouse production systems. The research can be described as applied research with the orientation to practical applications. The UoA's staff has a wide scientific profile including engineering physics, building physics, agricultural engineering and animal husbandry. UoA's concentrates on the animal environment, the working environment for humans together with efficient energy use and emissions to the external environment.

Although the focus is in the animal husbandry the Panel found the scope of research rather wide considering the size of UoA. In general, the multidisciplinary approach is justified due to applied nature of research where the interactions between animals, workers and building environment together with emissions to the surroundings are studied and modelled.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA showed solid quality of the research. Their poultry laboratory enables experimental research in the poultry production. Success of their activity is based on good connections with practice and ample own practical experiences. The scientific productivity, particularly in view of the small number of staff, is high. The group published in the period of assessment 70 papers overall which are on average nearly 13 per researcher giving the clearly above average output within Biosystems Technology Group. The UoA received 2.7 citations per paper however, had no papers in the Top 5% within their sub-field, probably because of their applied approaches. A considerable part of their research activities are recognized internationally, e.g. by CIGR. Therefore the scientific quality in combination with the high output was rated as internationally recognised (4.0) in spite of the shortcoming mentioned above.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA has a significant national role especially in the reduction and control of ammonia and compounds creating odour emissions from variety of husbandry animals. The main audience and users of the results are the industries related to animal production. It is evident that the UoA is a trusted independent source of opinion.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

UoA's work is highly relevant to sustainable production of food taking into account the animal welfare and work safety. Particularly occupational health and work safety questions recently gain more importance in Europe and worldwide. The unit contributes important information to this field. Impact of results could be more extended to the scientific community and society.

The work has national and international significance in the short and medium term. Limited resources in research, however, reduce its impacts to larger forums.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The group does not have clear vision about the focal points of research. More international contacts and larger number of PhD students are needed to ensure scientific regeneration. The age structure of the UoA with a key member near the retirement age causes concern. The Panel encourages the further building of strategic partnerships with neighbouring technical universities and suggests investigating possibilities for closer cooperation within the faculty including mergers to formulate larger UoAs. This should enable greater success in fund raising.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Not applicable

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The UoA has connections with practical animal husbandry and their results are utilized in the sector. However, the UoA has not been able to convert this interest into obtaining funded projects. It is recommended that the unit identifies their core expertise and also puts effort into seeking strategic partnerships, networks supporting fund raising in this core area.

B 5. Additional information

It is recommended that SLU should organise multi-disciplinary conferences among the different UoA in order to identify greater synergies within their work.

Part B: Report on individual Unit of Assessment

Panel 9, Biosystems Technology

Unit of Assessment: 637_2 Landscape Development with a Natural Science / Technical Approach

B 1. General assessment of the Unit of Assessment

The research of the group was started in 2007 and deals with the design, materials, construction and maintenance of parks, gardens, traffic-affected environments and other urban outdoor environments, as well as the management of peri-urban landscapes. The group develops sustainable solutions, for example the use of natural stone, as one of a number developing priority areas. The group uses landscape laboratories where model landscapes can be planned and developed as “prototypes” in near real size to study any issues that may result from the novelty of design before actual construction. One of the future research goals is to determine a better understanding of the plant-soil interaction under these conditions. The Panel believes this to be a unique approach in the research aspects of landscape design, which include both the human requirements and environmental factors to be considered. This is important to fulfil future societal demands in regard to achieve a clean, functional and attractive urban environment.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The output of research reports is relatively low because the UoA has newly started and has a high teaching load. The teaching load is the highest amongst all UoA's handled by the Panel. To obtain results the group has been dependent on help from other parts of the faculty. Their scientific profile has until now mostly been applied work and their work seemed to be quite unorganized. The group has for example attended as a part of a bigger group in an architectural park planning competition and achieved good results. The UoA is having a part time professorship but will have a new professor appointed this summer. This should increase the quality of their work.

They are unique in Sweden, having collaboration both within SLU and other universities and research institutes. The scientific quality in classic research terms was rated as ‘inadequate’ (2.0). However, they have other objectives associated with their mission and output.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The UoA is able to lead the practically orientated scientific debate in landscape planning in the special field of urban outdoor environments and in the management of peri-urban landscapes. This includes solutions for water and sewer pipelines in relation to planted trees and their roots.

Alnarp provides an attractive research environment with good facilities such as outdoor landscape laboratories. The staff is well motivated and has built up links to other relevant research groups both nationally and internationally. We believe that the UoA will have the possibility to be an even more trusted independent source of opinion in society when it will have a new professor. We believe there is an opportunity for this group to be further developed with this new leadership. The present recognition and leadership was rated as 'moderate' (3.0).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA displayed good potential for producing practical recommendations and guidelines for matters related to landscape planning in urban environments. They have been active in giving advice through the internet together with the Modium portal. The group has achieved a 'Journal Normalized Citation Score' of 2.2 and a 'Field Normalized Citation Score' of 2.98 giving the highest output within Biosystems Technology Group in those two categories. The panel considers that this group will develop and increase its output under the new leadership. The relevance and impact was rated as 'moderate importance' (3.0).

The work has national and international significance in the medium and longer term. Thereby it contributes to creating new urban landscape.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The future potential of the UoA is high because of an anticipated increasing demand in this area of work. The strategy of this group is to appoint a scientific leader both for soil, plants and hard materials in the urban environment. Additionally they motivate co-workers to qualify for "appointments" as Senior Researcher or Associate Professor. These are presently plans, which are not yet realised. The strategy and potential was rated as 'good' (3.0).

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

The UoA should develop more international links which will increase their presence and help attract graduates to their area of research in the future.

B 5. Additional information

SLU should help to create links between their research and towns and communities which are interested in urban green-spaces. It is recommended that SLU should organise multi-disciplinary conferences in order to identify greater synergies with their work.

Report– Part A: General Assessment of the Research Field

Panel 10. Plant Protection

The UoA's in the Plant Protection research field (#10) displayed a wide spectrum of performance with regard to their research endeavours, in both quality and overall productivity. Several of the UoA's were ranked by our panel as among the best comparable units in the world. Indeed, these research groups are considered to be leaders in innovative thinking and energetic action, and they have a record of attracting top-notch students and postdoctorals to join their groups. With one exception, the UoA's in this top category have benefited from, but have also actively sought and nurtured, dynamic interactions and cooperation with researchers in other UoA's that have skills and intellect that complement and strengthen their own program. The synergy that is exhibited among these units is certainly a large factor that has contributed to the high quality and volume of scientific output to the world's science communities in these fields. The other UoA with an equally high ranking with regard to quality of science leadership, and relevance/impact is very large, in a different discipline than those above, but within their quite broad discipline has again promoted a high level of cooperation and sense of common mission that spans the most basic to the most applied research thrusts in this unit. Thus again, our evaluation panel sees that when there is a high-energy research vibrancy, insight and innovation in one of these top-ranked UoA's, communication and collaboration among researchers having different skills at different levels of inquiry (molecular, organismal, ecological, etc.) has been a common theme. The panel also observed that such cohesiveness and common sense of purpose has not come about by accident, but has been engendered by a skilled senior leader with the vision to ask the right questions and who knows how to assemble the correct blend of junior and senior researchers to form an effective high-functioning team.

At the other extreme, several UoA's in the Plant Protection research field were seen by the panel as exhibiting a kind of fatigue, and they have languished relative to the top-performing UoA's for various reasons. Senior scientists in these UoA's seem to have been disheartened by recurring problems such as an inability to make long-term plans caused by the short-term nature of many grants. There is uncertainty about the ability to re-vitalize a UoA with PhD-level researchers, coming in part as a consequence of 4-year PhD students being awarded only 3 years of funding. Other factors include recurring administrative reorganizations and the dearth of university line-item-funded professorships and associate professorships. This creates a need to first find funding for one's own job before being able to acquire and allocate funds that employ one's research team to actually perform the science. This doesn't leave much time for, or create much confidence in, charting out future lines of inquiry that might result in innovative and productive science. It's a hand-to-mouth existence that translates into short-term, reactive science rather than proactive long term science. In some cases, geographic hurdles that arise from the huge distances of separation of the SLU campuses have been an impediment to the development of teaching and research programs for faculty. Yet another factor in some of these lower-performing UoA's can apparently be attributed to a lack of a unit leader professorship to provide vision and establish a core sense of purpose for these groups. We must note here that these UoA's are almost all moderate to small in size, and

seem at this snapshot in time to have become orphans, in a sense, as a result of their somehow having lacked a natural affinity with the missions of other, larger UoA's.

A few of the intermediate and low-performing UoA's have FOMA missions, and more, still, have significant expectations of delivering useful results and techniques to end-users in industry and the public. In most cases the scientists in these units do an admirable job in fulfilling these missions. They manage to balance the difficult tasks of serving these end-users and meeting their expectations with useful products while at the same time maintaining a successful and forward-looking research program that supports PhD students and other junior scientists. Although the researchers in these UoA's performing FOMA activities are highly dedicated to their mission and perform it admirably while being significantly under-funded, they hold the prospects for continuance of their efforts in doubt due to the need for yearly renewals. Here there is the irony of a program based on long-term monitoring of long-term trends that is, on a yearly basis, threatened by a termination of funding.

Some of the medium-to-low-performing units in Plant Protection also seem to suffer from a possible disconnect between their relevance-and-impact oriented missions, that do not match the new metrics of scientific "excellence". The scientists that are dedicated to performing more applied missions labour in an environment in which publication in the primary scientific literature is not as easy or as valued to their audiences as is actually making things work out in the field for farmers and foresters. Any agricultural university anywhere in the world must ask itself whether imposing a single standard for scientific excellence based on citation counts and H-factors is an effective way to create a big tent that welcomes all types of agricultural researchers. Perhaps the goal of SLU to value a university-wide level of excellence, created by a balance of high-performing UoA's in basic science and by others in performing excellently in delivering useful knowledge and techniques, can be achieved by not over-emphasizing numbers produced by bibliometrics.

The future potential of the highest-performing UoA's is, in the assessment of our review panel, as good as, if not better than, any of the top comparison groups in the world. The infrastructure, core facilities and equipment appear to nicely facilitate the experimentation and innovative explorations of researchers in these groups. The collective intellect of these scientists and their leaders has been allowed to be expressed and to flourish as a result of the fertile scientific environment created by the SLU administrative leadership.

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 309_1 Plant Soil Interactions

B 1. General assessment of the Unit of Assessment

This is a world-class unit that is pushing the field of microbial ecology forward in multiple directions. The biometric indicators paint an impressive, and we would argue, accurate picture of the productivity and impact of this unit. All five indices are very high, meaning that this unit is publishing numerous, important, and highly cited scientific papers. The outlets selected for publication include many highly regarded ecological, mycological, and general interest scientific journals. The range of topics, methods, and questions is similarly impressive. The group has been quick to embrace new technologies such as high-throughput sequencing, genomics, and stable isotope analysis. They have combined these with a large repertoire of standard methods to dissect complex below-ground ecosystems at multiple scales and to produce unprecedented views of diverse microbial component of boreal forest and agricultural ecosystems.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This unit is the best in the world in the area of mycorrhizal community ecology. They have been quick to adapt new methods, and have used them to tackled difficult and scientifically interesting questions. This is a very large, active field, with many researchers in Europe, North America, Australia, and Japan. However, the only group of similar size and breadth is the Aberdeen/ Macaulay Institute group in Scotland, and this group cannot really be characterized as competitors as the SLU group has collaborated with them on multiple occasions. In addition SLU's expansion into pathology and rhizosphere interactions in agricultural systems is opening up many new, productive lines of research that broaden them out in ways that other research units in the field have not yet done.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

As mentioned above this group is clearly leading the field, and perhaps more importantly they are connecting it to the broader field of ecosystem function. They are known for a high

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

standard of research excellence and are directing their attention to important questions. The prominence of group leader, Prof. Finlay, is evidenced by his two SLU awards, and his position as executive editor of *Fungal Biology Reviews*, his roles in the planning of disciplinary scientific meetings, and his many invited talks. In addition other researchers (current and recent past) in the group serve as editorial board members on *Fungal Ecology* and *The New Phytologist*.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group has a strong focus on basic research. As such much of the work produced will not have immediate application, but instead will build on our fundamental understanding of complex natural systems. This type of knowledge may in long run lead to unanticipated applications that could only be achieved through such an understanding of these systems. However, a least a portion of the work is also directed at more immediate application. Their work on mycorrhizal colonization in nursery settings, their work on mycorrhiza in agriculture, and their expansion into pathogenic interactions are two examples.

The geographic scale of their work is focused primarily on Nordic ecosystems, but the below-ground component of these is highly complex and serves as a model for boreal forest systems across the Northern Hemisphere. The group is highly collaborative both within SLU and across Sweden, Europe and North America. In particular their expansion into genomics has included Stenlid's group at SLU, Tunlid's group in Lund, Martin's group in France, the Joint Genome Facility in the USA. Their community ecology and ecosystem work generally involves short to medium-term experiments, but these are often coupled with parameters linked to global change, and this focus lends a large-scale, long-term prospective to their work that substantially increases its impact.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The trajectory for this group is impressive, and will likely continue to translate to many more high-quality publications in the years to come. Both age and gender are well balanced within the group. Women actually outnumber men by almost a 2 to 1 ratio in the unit, and women are at least even in number at all levels, include the ranks of Professor and Researcher. Similarly the group is rich in young talent, and active in graduate training. At the PhD level this group is predominantly female, and thus the long-term effect is likely to flip the usual gender imbalance on its head. The unit is highly collaborative and has enjoyed multiple synergistic interactions especially with Stenlid's Forest Pathology and Mycology group as evidences by many co-authored publications.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

There is no FOMA funding in this unit, but much of what they do in terms of rhizosphere community analysis could be used as a framework for such monitoring, if distributions of fungal or microbial species become part of a more holistic ecosystem assessment at a future date. As these organisms are critical for growth of the dominant tree species one could imagine including them in an expanded survey effort. The reality of this view is exemplified by the groups planned participation in the EU Baccara project that involves biodiversity assessments and projections in a global change framework across Europe.

B 4. Actions for development at the Unit of Assessment

The group has laid out a realistic plan for future development. Expanding inclusion of molecular biology and genomics is planned and will clearly lead to more international collaborations. Part of their plan includes needed equipment acquisition, and this is necessary as Research in this unit has been driven in part by inclusion of the state-of-the-art techniques and equipment. To maintain their world-class position and leadership continued investment in core infrastructure will be needed. Their identified needs include a new Phytotron facility to be included within the Biocenter, and it is this committees opinion that that is an absolutely necessary investment for SLU to make if they wish to insure the continued excellence of this group. In addition expansion of high through-put sequencing capacity, confocal microscopy facilities, and Mass-spec and NMR facilities will all be needed to fulfil the future research plans of the active unit. Although acquisition of such equipment will require substantial strategic investment, we note that all of these facilities would open up many new avenues of research for other units on campus, and could lead to new innovative collaborative projects and would make SLU a research Mecca for scientists around the world.

B 5. Additional information

The undergraduate teaching capacity of this unit is certainly underused, and when queried about this, our committee found that they felt that other units on campus monopolized some of the courses that they were qualified to teach, and some of their most relevant clientele were on other campuses. This affects their research in an indirect yet significant way, because the formula of 20% campus support, 50% research support, 30% teaching is based on model in which teaching is an option. When it is not, it means the remaining 30% of the support for individuals is difficult to assemble, as research support from individual grants is capped at 50%.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 390_2 Agricultural Plant Pathology

B 1. General assessment of the Unit of Assessment

This unit shows outstanding scope of vision and potential for scientific quality, relevance and impact. Agricultural Plant Pathology is coordinated by Prof. Dan Funck Jensen, who joined SLU in April, 2008, bringing expertise in the use of fungi in biological control of fungal pathogens and in fungal-plant interactions. The group is taking shape under an ambitious plan for strategic recruitment of a fresh research team, coordinated with existing team in Forest Pathology and Mycology. Interdisciplinarity, industrial, agricultural, and academic collaboration, and commercialization are strong themes. There are two main components: fungal interactions and assembly and function of fungal communities in crops. The interactions part will take a system already investigated by Dan Funck Jensen toward development as a deployable biocontrol system in crops. It will also investigate mechanisms of fungal interaction towards commercial development of some enzymatic mechanisms with companies such as Novozymes A/S. Fungal community structure and function in pre- and post-harvest crops, residues, and silage are proposed that could inform agricultural practice and provide basic ecological data on community assembly and function under different cropping practices. For example, potential for production of fungal toxins, potentially dangerous to livestock, is being evaluated from a survey of fungi in stored ensilage. Technology for both phases of the research program includes high throughput sequencing as well as appropriate bioinformatics and molecular biology – all of which are supported by existing infrastructure and are within the experience of the present team or local collaborators. Collaboration among the three UoA's in the Department is already strong, as evidenced by authorship of publications. Collaborations on local, Nordic, EU scales, as well as in developing nations, are highlighted in the plan. Recruitment and training appear to be on schedule. The scope of real and potential private and public sector funding presented to us was impressive. This program is already showing results; the best is yet to come.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Although this unit is new, with a small group, there is very good productivity built upon both work carried over to SLU by Dan Funck Jensen from his previous position and projects in progress with Assistant Professor, M. Karlsson. For example, there is the constellation of work around gene evolution of chitinases, enzymes that can degrade a key fungal, insect, and crustacean wall component, chitin. State-of-the-art genomic and bioinformatics approaches have revealed a previously unknown diversity in this gene family and a fascinating evolutionary trajectory. Their biological role is now being investigated by means of gene knock-outs and quantitative tools for studying gene expression, first in a highly tractable

model system, then in a ubiquitous and highly competitive, soil-borne fungal parasite of other fungi, *Trichoderma*. This research should be of general interest and high visibility, with further development via protein engineering for industrial exploitation. Already there are at least three, high quality publications. The project showcases the ability of the group to approach a problem from several directions, to apply the best technologies to achieve scientific impact in publications, as well as to leverage for commercial development.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Taken as a whole, the unit will be situated in the new BioCenter within a vibrant Department in an excellent research neighborhood. The unit has approximately six people, with two faculty. A team is being built. At present, all units of the Department meet regularly and there appear to be no boundaries in cooperation and collaboration. The unit is active in teaching in plant pathology at all levels (although FTEs are not presented for teaching in the self assessment). Ph.D. training is leveraged by co-supervisions. There are a total of 5 Ph.D. students supervised either with other units in the Dept. (two), or as co-supervisees on a Danish project (one), or through arrangements with other departments (one at SLU, one with KU-Life, Denmark). Courses for Ph.D. students from Nordic and Baltic countries, as well as Russia, also attended by postdoctoral trainees are another facet of teaching in this unit.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The unit is addressing agricultural and agro-industrial problems in plant disease through original research, collaborations, entrepreneurship, and teaching. The design of the program has enormous potential. Outcomes for relevance and impact will depend on execution.

The strategic plan of the unit is regional, Nordic/European, and global – with an explicit development plan in Iran and Africa. Time scale is explicitly short-, medium-, and long-term.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

If the Agricultural Plant Pathology group can continue to match its ambitious plans with personnel and financial support, there is potential to create a highly original and modern program in plant pathology that combines the traditional aspects of disease prevention and

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

management, mutually beneficial cooperation and collaboration with stakeholders, primary research of high international caliber, and entrepreneurship. The strategic plan is visionary. There has been good progress so far. Stakeholders will be growers, agro-industry, and industrial developers of the enzyme products spun off from basic research. We believe that the culture of this Department is conducive to realizing the strategic plan for this new unit.

On the basis of this evaluation, award a score from 1-6 ⁴:

6

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

Not applicable.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 390_3 Forest Pathology and Mycology

B 1. General assessment of the Unit of Assessment

We were enormously impressed by the quality of this unit. This is clearly a world-class group engaged in outstanding science that is on an upward trajectory. The coordinator of the UoA, Prof. Jan Stenlid, is commended for providing us with (a) a self-assessment that clearly identifies strengths and challenges and (b) one of the most enthusiastic and substantive in-person presentations in our assessment experience at SLU. The group has one of the best staff complements that we saw: 12-13 Ph.D. students, 5 Post Docs, and 9 researchers and a Professor. The mix of research, service, training/teaching, and involvement in Swedish initiatives seems ideal. The group is well-funded, its people can focus on doing great work and they convey well-being. Everything from DNA sequencing, to chemical analyses, to microscopy, to plant growth facilities, to computer clusters, to facilities for tree breeding are available. The expertise is available. The Department is moving into what we expect will be a first-class facility, the BioCenter, which will afford a vibrant multidisciplinary neighborhood with ready access to facilities, people and ideas for both molecular and plant interaction work. This unit does the short and long-term work associated with Forest Pathology and Silviculture as well as cutting-edge work on fungal biology. They are, without qualification, the world leaders in the study of fungal forest diseases and the practice of forest pathology, as well as world-class practitioners of advanced research in the biology, ecology and genomics of fungi – both fungal agents of tree diseases and filamentous fungal model systems from which we learn about mechanisms. The connection between “pure” research and practical outcomes coupled with the open intellectual environment in the group clearly provides an outstanding educational environment, as evidenced by the graduates of its Ph.D. program and their success in a range of placements from this unit at SLU to research and administrative positions in Nordic Countries, the EU, and abroad. This group continues to attract international researchers as well, both at the student level from industry and “sandwich” situations, and at the more senior post doctoral and visiting scientist levels. The group is hitting its stride. We anticipate that it will (a) stimulate (through example and collaboration) the development of the other groups in the Department, (b) grow in reputation as an international center for fungal research, and (c) set a world standard for the practice of Forest Pathology, not in small part by its ability to contribute to improving forest health in Sweden.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This group sets a world standard in Forest Pathology research. Notably, the past ten years of ecological research has been conceptually rich and highly original. For example, the work by BD Lindahl and coworkers on spatial separation of litter decomposition and mycorrhizal nitrogen uptake, which is built upon some earlier and very well-cited papers from this group. In another area, it is abundantly evident that this group knows how to apply cutting-edge molecular, genomic, and bioinformatics tools to maximum advantage. The savvy shown in the execution of the *Heterobasidion* genome program is a case in point. From this large-scale project we will see the first functional analyses of pathogenicity factors in a perennial (tree) host - other fungal genomes to date have been crop or animal pathogens, model systems, industrially important species, or species of unknown evolutionary affinity. This group at SLU is really doing this strategically for maximum impact and efficiency. In addition to the reference sequence, they have sequenced 23 individuals (total of 24) from which they will be able to follow sequence divergence at the population level (population genomics) AND they have sequenced related species, from which they can identify candidate genes for host specialization and other mechanisms of evolutionary diversification. They have been proactive and have precisely identified the cutting edge in population genetics and speciation biology ahead of many other groups. In contrast, other consortia have sequenced only one individual. With Junior Researchers, e.g. B. Canback and others, they have the bioinformatic skills to exploit the data. So in terms of originality of ideas, choice of methods, impact and productivity this is a model group. The unit has high visibility as a group internationally. They are involved in programs such as STINT, promoting international exchange in research, Ph.D. training and teaching. Students from the unit present at important international meetings and acquit themselves with distinction.

Productivity is excellent; we feel that the bibliometric analysis does not represent this adequately, possibly due to the small Forest Pathology community that my limit citations. In any case, the unit is publishing in a mix of journals, e.g. forest pathology journals with lower impact but great importance to the field versus general journals such as *Molecular Biology and Evolution* or the journal *Evolution*. This is far beyond the standard for the field. This group is on its way up in publication impact. The *Heterobasidion* genome has potential for a top journal such as *Science* or *Nature*.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The group and the Department are an ideal place to work on mycorrhizal, saprotrophic and agricultural pathogens. There are formal collaborations with funding with *Salix* breeders at VBSG and Agroenergy AB, microbial ecologists at Uppsala Microbiomics Center, and notably, with the Future Forests consortium. There is a collaboration of long duration with Skogforsk on resistance biology in trees and forest management and a bond forged through migration of completed Ph.D. students in the mycology group at EBC Uppsala University.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

There are collaborations on wood phenolics and terpenes with KTH - Royal School of Technology, Stockholm, not to mention work on indoor fungi with the Dept of wood technology at SLU, Uppsala and Oslo University. The group coordinates the Heterobasidium genome project with JGI, USA and 10 partners, as well as a network on diseases of native and plantation trees with East Africa and four partners, and FORTHREATS (Invasive forest threats in Europe), with 23 partners. This group is clearly a leader in many areas of research pertaining to fungi and forests. The authority of this group in these areas of knowledge is obvious to us.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA is recognised by the forest sector in Sweden as the leading experts on forest pathology. Their work on root rot is important for both the basic scientific knowledge and for management. They also provide knowledge and vital service for the forestry and their nurseries through their field-mycologist and other staff. Despite that the UoA no longer belongs to the Faculty of Forestry it has several long-term interactions with the Forest Industry, mainly through the research programme Future forests. The UoA is aware of this problem, and we share their view that cooperation in larger programmes is necessary. The www-site Skogsskada appears to be widely used (72000 logons per year), on basis of the statistics presented by the UoA. However, at present some of the functionality of the site is restricted (see also report for UoA 415_7). The reporting system for diagnosed diseases in the field is sparsely used. For instance only a handful of observations for the major forest pests have been reported to Skogsskada the last couple of years, despite large outbreaks by for instance bark beetles and *Gremmeniella*. This service is probably possible to expand to the other Nordic countries, which could reduce costs and increase Nordic cooperation. More work is needed to secure long term funding to vitalise this service, which could be a part of the UoA's FOMA-activities. The UoA has an excellent knowledge of identifying fungal pathogens, and could consider advocating that the future FOMA on forest pathogens is based on using these techniques on samples that could be sampled in national-scale inventories, or sent in by the forest sector. However, then national surveillance of forest pathogens must be identified as a relevant FOMA by SLU and forest authorities.

This unit is strategically planning on local, regional, EU, and world scales, with development activities in Africa. There are plans at all time scales; in fact this is a model group in this respect, as silvicultural work is a 15-20 year proposition, yet graduate students must be trained in four-year time-frames!

On the basis of this evaluation, award a score from 1-6 ³:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

We have outlined the considerable strengths of this group in other sections. The move to the BioCenter, where this vibrant Department will be together with other departments in a synergistic research environment – a good neighbourhood - bodes well for the future. This unit functions in a Department with an excellent culture of openness and cooperation. We see the unit, the Department, and the group in the BioCenter as a whole, as strategically positioned to move from strength to strength. It will be important for this unit to increase the plant disease footprint in FOMA – climate change and invasive species present big challenges to forest health.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

The UoA is the authority on identifying fungal pathogens, and is positioned to ensure that future FOMA assessments of forest pathogens include monitoring of pathogens from samples that are could be made from those already collected in national-scale inventories, or sent in by the forest sector. It could be as easy as collecting small cores and putting them in small vials of DNA extraction buffer for shipment. However, then national surveillance of forest pathogens must be identified as a relevant FOMA activity by SLU and forest authorities.

B 4. Actions for development at the Unit of Assessment

We think the current activities of the UoA are excellent. They would like to see forest diseases as more focal in FOMA monitoring and assessment and we agree.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 390_4 Epidemiology of Plant Pathogens

B 1. General assessment of the Unit of Assessment

This unit is small with one active professor, one lecturer, one recently added researcher and several PhD students. The two diseases that receive the most attention are potato late blight and stem rust of cereals (oats and wheat). Both diseases represent major challenges in terms of environmental and economic issues. Whereas stem blight has been somewhat mitigated by resistant plants recently, that situation is challenged by a new strain of rust, UG99. The potato late blight disease is spectacularly important both for economic and environmental reasons. It accounts for nearly 50% of all fungicide used in Sweden. The disease is a challenge throughout the world – with similar reliance worldwide on fungicide. Efforts for the past century have aimed at improving disease management, but fungicides remain important in commercial agriculture. This is especially an issue in Sweden, where there is significant pressure to reduce fungicide use. The group has become particularly visible within the potato late blight research community recently because they have demonstrated that *Phytophthora infestans* reproduces sexually in the south of Sweden – exacerbating the challenge. They have received worldwide publicity for that discovery. One of their major future goals is to understand why this organism is sexual in this location but is not sexual in many other locations. They are also well known because of their contribution to collaborative teaching in Nordic countries. There are many multi- and interdisciplinary collaborations within SLU and also external to SLU.

The research accomplishment is very important and visible to the potato late blight community and within epidemiological plant pathology.

The group has published very broadly on a diversity of topics. This breadth illustrates the application of epidemiological techniques and tools to many questions, but it probably does not emphasize the visibility of the group to any specific audience. There have been many collaborations.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The group has many collaborations and has contributed to many projects. The skills of the group are clearly crucial to many diverse activities that are not centered in the group. However, this interdisciplinarity and collaborative activity has probably limited the visibility

of the group outside those projects. It would be appropriate for the group to identify a particular focus that is uniquely theirs, and to begin to think beyond the constraints of the pre-genomic methodologies.

Among theoretical plant disease epidemiologists around the world and within the potato late blight community the group is well recognized.

The panel was concerned about the emphasis on investigating the reasons for sexual reproduction of *P. infestans* in southern Sweden. While important, this situation appears very difficult to understand because the techniques for addressing this question seem uncertain, and the specific hypotheses are not yet crystallized. It seemed as though a genomics approach would be necessary, but the group does not yet have such expertise, nor does it seem interested in developing one.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

In epidemiological plant pathology, the group is well respected and has and will lead and participate in such debates. The group is highly respected and certainly is appreciated in its many collaborations. The analysis of decision support systems is particularly impressive in terms of theory, and the practical application is important. The group is very young with a developing reputation. The group can now decide its future directions. Selection of a few central themes will raise the visibility of the group.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group is very young, and has only recently been incorporated into the department. The professor has only recently been identified. Despite this, the group is clearly accomplished with significant potential. The major challenge for the group is to establish a unique identity. Because the group is quite young, and has been grown from within its identity is still in development. The direct relevance and impact of epidemiology was debated within our panel, and we concluded that the finding of sex in *Phytophthora* has important implications for management of the disease, but we were sceptical of the long-term practical impact of further work in this area.

Accomplishments of the group are clearly known from a local to a global scale. The reputation is clearly stronger in Nordic/European than on a global scale. Individuals within the group are known, but the group itself is just beginning to acquire an international identity. The contribution to Nordic teaching is impressive. These contributions to date seem likely to

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

contribute mainly to long term impact. Investigations on the sexual reproduction of potato late blight may have short term impact, and if so, will also have long term impact.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The research potential of this group is high, but they are young and are still in process of defining their goals. As might be expected with any young group, the goals of the group are still in development. With more persons and with time and accomplishment, these goals will become more clear and more focused. We expect the group to inform the future direction of plant disease epidemiology worldwide and thus to play a worldwide leadership position. Some of the current more specific goals (understanding the reason for sexual reproduction of *P. infestans* in southern Sweden) may be very difficult.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

This group has no funding from FOMA, but there is funding from EU concerning very practical/monitoring issues. The UoA has certainly contributed significantly to the EU understanding of the population biology of *P. infestans*.

B 4. Actions for development at the Unit of Assessment

This is a young group that has contributed significantly to host resistance studies, plant disease management theory, human cancer research, rust diseases and population studies of the potato late blight disease. They have contributed significantly to understanding of the population biology of *P. infestans* in Sweden. The group is very bright with a very diverse background. However, that diversity of accomplishment/interest has limited their visibility in any one area. They need to focus on a central theme(s) around which they will become known.

B 5. Additional information

The group is clearly in transition and has a bright future. The appointment of a faculty funded professor in 2007 is an important step to aiding the group and realignment in a new department is also an important positive step. It seems that the current administrative alignment is good and should be maintained. The next steps for the group are to intentionally develop an independent identity and adopt more cutting-edge technologies while maintaining the excellent tradition of collaboration and cooperation.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant protection

Unit of Assessment: 415_1 Insect - Plant interactions

B 1. General assessment of the Unit of Assessment

The research performed by the group "Insect-Plant Interactions" appears to be well founded on relevant theory, applies modern advanced concepts and techniques, and addresses interesting questions with high relevance to the research field, as well as to its practical applications in agriculture and forestry. Despite its seemingly coherent basic approach, the research appears to cover somewhat disparate topics ranging from population dynamics of insects on willows, to biodiversity and climate change, to the interaction of aphids with barley genotypes and their mixed cropping, and to risks of GM crops. The group addresses nevertheless this wide range of topics at a considerable depth, and is on its way to describing some of the underlying mechanisms of the ecological processes observed. In general, however, the research appears to be descriptive in nature rather than asking the (far more challenging) "why-questions". Although the group does not appear to receive funding for FOMA, many of their results and activities directly relate to the objectives of environmental monitoring and assessment (e.g., those related to climate change, invasive pests, GM-crops, and in particular the project on "Future Forests").

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Some of the discoveries by this group, and the ideas leading to these results, are fascinating and new (e.g., interactions between barley genotypes and their impacts on aphids - still much to be explained; interactions between willow genotypes and a gall midge - putative hypersensitive reaction, which is rather unique to insects but needs to be verified; and the influence of temperature [climate change] on trophic interactions). The group uses both 'classical' entomological methods as well as modern molecular techniques, and is prepared to take up more of these in their future work. Despite the high potential for intriguing scientific output, the publication record of the group as a whole is only middle-range. This includes nevertheless several highly cited and valuable contributions in excellent journals such as *Ecology*, *Ecology Letters*, *Ecological Applications*, and the *Annual Review of Entomology*. Thus, the group's Normalized Journal Citation Score is well above the SLU average (1.29). The Insect-Plant Interactions group already has demonstrated outstanding international prominence in certain aspects of their topic area, occasionally rivaling their 'benchmark' international institutions. They also have developed a good network of collaborations between both domestic and foreign institutions, and are involved in a new EU-project focusing on

climate change and biodiversity; these activities might still be further expanded.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The senior scientists in the group are highly qualified and respected experts in this research field, well capable of advancing science and of leading the scientific debate within their 'spearhead' topic areas. Their active guidance and supervision of younger scientists (weekly and monthly staff meetings, seminars, etc), high motivation and enthusiasm for their work, as well as good infrastructure and valuable international contacts provide an attractive research environment for young scientists. The group has successfully supervised 6 PhDs during the past 10 years; unfortunately the current number of doctoral students is very low. The unit has participated actively in dissemination of their research results to the society at large, and regularly provides expert opinions to governmental and regional agencies, forest companies, farmers, and the general public. The unit also was largely in charge of organising the most important scientific symposium within the topic area (Symposium on Insect-Plant Interactions, in 2007) in Uppsala.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The unit is focussed on finding solutions for sustainable forest and crop management, based on solid research and discoveries in the area of insect-plant interactions. They have an excellent potential to significantly contribute to these societal aims, and even more so because they focus on problems on major crops and tree species (barley, willows, pine). These are also a basis for very large industries, potentially improving the sustainability of their resource base.

The general scientific discoveries by the group clearly have a global impact on the scientific community (e.g., those related to climate change, or ecological principles and mechanisms), while their specific applications (e.g., aphids on barley) can have significant impacts largely at the national, or at the North-European level (e.g., in the areas where barley is grown). These impacts in general tend to require medium- or long term perspective, simply because ecological field tests to demonstrate their applicability is time-consuming.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

Being a recently formed unit, it still needs time to fully develop its potential. The unit realises the importance of networking with other units (within-department, other domestic, and international) in order to complement their expertise in strategically important areas, and is prepared to proceed in that direction. Their own skills and research ideas are solid, and can best be pursued in multidisciplinary, synergistic consortia. The intended hiring of 2 new PhD-students (May 2009) will also give additional momentum to the unit's work. Currently the gender balance in the unit is ideal: 50-50.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

NA

B 4. Actions for development at the Unit of Assessment

Increasing further the collaboration with other units will strengthen the research; this is already likely to happen within the Future Forests -programme. Even more active engagement in international research consortia (EU, COST, Nordic ...) will similarly have the potential to boost the positive development of the unit. International training of PhD-students could also yield highly positive results and increased international contacts; e.g. active participation in NOVA network's PhD-programmes and other international programs will be useful.

B 5. Additional information

1. Provide incentives (financial, job-security, or other incentives) and mechanisms for increasing interdisciplinary collaboration in research.
2. For senior staff, it would be very important to create a system of sabbatical leaves so that they would have a possibility regularly to spend a year elsewhere - this would enhance international collaboration enormously.
3. Provide full-length support to PhD-students (but assess performance and quality annually).
4. Provide longer-term research grants to enable longer-term ecological field studies in multidisciplinary settings

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 415_3 Agricultural Entomology

B 1. General assessment of the Unit of Assessment

Agricultural Entomology is a relatively new unit of organization, but scientists now in this group have a long history of discovery, publication, and outreach in their areas of responsibility, broadly defined as the protection of agricultural crops from arthropod damage, pollination ecology, and maintaining the health of honeybees. Their original research findings are published in upper tier of ecological journals or in appropriate entomological journals. Their rate of publication is high and the impact of most of their scientific papers on this discipline is significant. Some of the specific areas studied are native pollinator ecology, routes of disease transmission in honeybees, and the food web structure of insect communities in natural and agricultural habitats. The relevance to agriculture of their findings on predator conservation at the landscape level may be to offer specific land use strategies that can lower the use of pesticides through improved biocontrol by natural enemies. Honeybees are of course crucial pollinators in agricultural crops and they are susceptible to several diseases. This UoA is the only group in Scandinavia studying honeybee diseases. This unit also has a very significant and effective outreach effort for education of the agricultural and beekeeping communities, particularly via numerous “fact sheets” and articles in popular scientific magazines. These deliver sound management programs to their stakeholders.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This unit has balanced hypothesis-driven inquiry while delivering to stakeholders practical programs for insect pest management and honeybee husbandry. This UoA publishes at an admirably high rate in ecological and entomologically oriented journals, all of which appropriate venues for disseminating their work. In the realm of discovery of principles, this unit is internationally prominent in studies of landscape-level plant protection based on conservation of biodiversity. They also contribute to our understanding of the role of non-honeybee pollinators in natural and agricultural settings. In honeybee management, studies have emphasized pathways of disease transmission and the interactions among disease levels and mite infestation. All of these studies address important questions for agricultural production and sustainability and they are hypothesis-driven. Scientists in this unit have many productive collaborations within SLU. This unit also has a number of collaborations with “developing” countries (Ethiopia, Uganda, Nicaragua, Baltic States), all of which deliver

training and pest management programs to these countries while increasing their capacity to conduct basic research.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

There are many signposts of strength in this unit. Over the 5 year interval of this assessment, they have published over 100 peer-reviewed papers, 40 fact sheets, and 60 “popular” articles in magazines and journals. The bibliometric analysis of their scientific papers substantiates this productivity and shows appropriate recognition in all categories. In their studies of predator conservation and food web interactions, they are international leaders. The investigations on the evolutionary epidemiology of honeybee pathogens is of great relevance to sustainable honey production and pollination services in Scandinavia and these studies have the potential to add much to resolving the current major controversies on honeybee colony health and colony collapse. It also is clear that this unit has strong commitment to educating the public via numerous popular publications and growers through fact sheets.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Pollination is of high importance in agriculture and horticulture. Pollinators are declining worldwide therefore knowledge of pest and forecasting pest outbreaks for honeybees are critical. The models developed are used by advisors and farmers. The group also works with developing models for forecasting of pest population dynamics and especially research on conservation biological control in cereals. These results can be used by farmers and advisors to be more precise in timing of spraying and to minimize use of pesticides. The outreach activities within the UoA are extensive both to farmers, plant protection centers, and other users such as the general public. In order to disseminate their own results and to be a link between the latest scientific knowledge to stakeholders the group produces on average 8 fact sheets and 11 articles in popular science magazines per year. Problems brought up by stakeholders' influences the scientific work and the dialog is also important for setting research goals. The UoA's continuous contact with beekeepers through diagnostic service gives the group working material and sector relevant feedback. The group has national responsibility for the diagnosis of bee diseases and is also a leading bee-group in an European perspective.

The Agricultural Entomology unit's focus is on mainly on Swedish agriculture, the exception being its interactions and projects in several developing countries. However, the principles being studied have global implications in agricultural practices and at a fundamental level in our understanding of food webs, pollination demographics, and disease transmission in honeybees. The impact of their work stretches seamlessly from immediate to long term.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

A major impediment to productivity is the unit's need to chase funding which often is relatively short term (at best, several years in duration). This greatly hampers the ability of these scientists to focus on their research and its implementation and it poses a special issue for the training of Ph.D. students who require a 4-year package of support. A corollary issue is the partial (20%) funding of many "tenured" professors. This practice creates uncertainty and anxiety and is at variance with practices in most university systems in other countries. One solution is to increase this percentage of support to a stable base, perhaps 50% excluding teaching (which itself offers variable support depending on the SLU unit and the number of students available). The current situation does not make academic positions at SLU very desirable. These issues are of course beyond the control of individual units of assessment. The Agricultural Entomology unit has a very good track record of acquiring outside support and they have a clear plan for requesting future support. This includes a major grant proposal (with SLU units, and Lund and Stockholm Universities), now in the second round of appraisal, and expanded collaboration with the Swedish Board of Agricultural. This UoA has sought to enlarge its research footprint by synergistic alliances with other SLU units and other universities in Sweden and beyond. It is to be commended for achieving gender balance.

On the basis of this evaluation, award a score from 1-6 ⁴:

5

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

FOMA has sponsored studies in two areas. One seeks to understand the role of generalist predators in biological control and the second pollinator ecology and pest control in organic clover. Both areas are scientifically productive, hypothesis-driven, and of relevance to understanding basic ecological processes. Such knowledge should provide techniques to improve agricultural sustainability. These studies are producing papers with good scientific visibility.

B 4. Actions for development at the Unit of Assessment

The efforts to understand the evolutionary epidemiology of disease transmission in the honeybee are being undertaken in part by analyses of disease susceptibility at the colony (as opposed to just the individual bee) level and also by determining the interactions of parasitic mite infestation with disease. This unique approach could benefit from setting up an international collaboration (and obtaining grant support) with another group that is mining information from the honeybee genome, possibly a team trying to determine the cause(s) of colony collapse, a particular concern in North America. The unit's work on conservation of biodiversity in agricultural settings (with a particular focus predator effects on pest insects) has produced a series of important, well-cited studies and should continue. Fostering

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

adoption of biodiversity conservation practices by farmers will be a challenge, but such cannot be encouraged without data from such studies. There are clearly a number of other efforts underway in pollination, pest forecasting, and development of new strategies of pest management. These activities are well linked with stakeholder needs. Issues of importance are the need for a stable funding base (to enable a reasonable planning horizon for research) and, given the breadth of pest problems, deciding which areas should be the focus of basic discovery research. To date, this unit seems to have struck an appropriate balance between hypothesis-driven inquiry and delivering practical management strategies to the stakeholders, but clearly there are not sufficient resources to address all of Sweden's agricultural pest problems. Future delivery of "fact sheets" probably should transition to a web-based system. The unit has addressed the need for future funding by applying for a grant to support a multi-university consortium to "harness biodiversity" and an effort to expand cooperation with the Swedish Board of Agriculture. This unit is in an excellent position to train Ph.D. students, save the lack of a stable source of funding.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 415_7 Forest Entomology

B 1. General assessment of the Unit of Assessment

The panel was favorably impressed with the performance of this unit over the past 10 years. This group has been highly productive, as is evidenced prominently in the bibliometric analyses that were provided to us. The publications list also showed that these researchers have published in a wide range of highly regarded scientific journals on topics focused on forest insect population and community ecology, host-finding behavior and colonization, chemical ecology involving antifeedants, and predator-prey interactions, among other topics. The senior researchers have published an impressive array of book chapters and review articles, a testament to their high standing in the field of forest entomology. The efforts of this group in FOMA are very good. They have continued their monitoring assessments of several key beetle pests in Swedish forests over the period of this evaluation and provided this information to end-users in industry and the public in timely fashion. There have been instances of a complementary relationship between the research and FOMA activities performed by this group, although the latter has at times sapped energy and time from research endeavors. The panel notes that this U of A has been highly efficient; they have done a lot in both research and FOMA on a fairly limited funding budget.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This is a fairly small, but tightly knit group that has performed innovative applied ecological research of benefit to the forestry industry and to the health of Swedish forests. They have researched and developed novel techniques to assess and to mitigate threats to forests involving several key beetle pests such as *Hylobius abietus* and *Ips typographus*. They have also performed research on other forest insect pests such as geometrid moth defoliators of conifers. They have published in an impressive array of high-quality journals, including International Journal of Ecology, Bulletin of Entomological Research, Physiological Entomology, Journal of Chemical Ecology, Animal Behaviour, Systematic Entomology, Journal of Natural History, and more. It is clear that their reputation as one of the premiere research groups in forest entomology is well deserved. They have established international visibility and links with researchers across the northern hemisphere.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

It is clear from the record in this group's self-assessment document and the bibliometric report that the researchers are leaders in their field. They have recently authored seven book chapters or review articles on forest insect pests that are of great interest to researchers in their discipline. Their recommendations and overviews are thus obviously requested and seriously considered by colleagues in the field. The members of this group have been active in producing reports, fact sheets and maintaining a web site to disseminate their findings to end-users in forestry. With regard to the public, 34 articles in popular science magazines have been published by the scientists in this group over the past 5 years to enhance awareness in society of their findings. This is strong evidence of their commitment to informing and engaging the public in awareness of the insect problems threatening Swedish forest resources.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

This UoA works with several questions that are relevant to forest owners and society. Population levels of bark beetles, and more recently also pine weevils, have been monitored in several places of Sweden since the 1990's. However, there seems to be no secure funding for this activity, and the unit has to apply for year-to-year financing. The web site "Skogsskada", which has been developed together with other pathologists at SLU, appears to function well as an information source about forest pathogens. However, in the present state the rate of reporting from the forest sector (forest authorities, private, companies) is too irregular to allow any conclusions about the levels of pathogens in the country. This service is probably possible to expand to the other Nordic countries, which could reduce costs and increase Nordic cooperation. More work is needed to secure long term funding to vitalise this service, which could be a part of the UoA's FOMA-activities. Some research innovation that developed into a potentially useful technology transfer effort occurred when senior scientists in this group conceived of and developed a novel and environmentally friendly non-pesticide technique to protect millions of pine seedlings from damage by the pine weevil. To their credit, they worked to obtain a patent for this technique and sought commercial partners to transfer this technology to industry. There is novel experimentation occurring involving potential new techniques for protecting conifers against colonization from the spruce bark beetle, *Ips typographus*. Researchers from this group have been innovative in trying to induce tree defences using a plant signalling compound known previously only to be effective on field crops. Their initial results have been exceptionally good, and indicate a new line of research to be pursued that will be of interest to forestry researchers and industry alike.

The geographical scope of the forest entomology group's impact reaches around the boreal forest areas of the globe. There is both near-term and long-term impact in their findings.

On the basis of this evaluation, award a score from 1-6 ³:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

If the forest entomology group U of A can attain long-term funding (4 year increments) that matches their collective vision and dedication to their field, they will be able to become sufficiently energized to be able to follow through on their research ideas as well as to work to implement many of their ideas for environmentally friendly technologies to mitigate forest insect pest threats. Although this group has been successful in maintaining their program on what appears to be a modest funding level, it is the year-to-year allocation of these funds that has limited their ability to hire PhD students. The yearly renewal uncertainties have also hampered their ability to plunge into many of the long-term studies of beetle pest population fluctuations that is at the core of this group's mission. There is high realizable potential in the forest entomology group's plan to nurture international collaboration in their research activities. Indeed, research groups from other countries look to the SLU team as leading the way forward and attract international attention that produces collaborative efforts. Continued collaboration with national stakeholders in the forestry industry and with the Swedish Forestry Agency are essential for future advancement of their scientific visions, as this group has articulated to the Panel 10 Review Team. If there is uncertainty about the future commitments from these entities, then this might cause these dedicated researchers to question the prospects for continued, future advances in the lines of inquiry and discovery that they have successfully developed thus far.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The forest entomology U of A has a modest FOMA involvement with respect to the budgetary commitment it receives. However, this group has continued to show an exemplary and continuing commitment to what it considers to be one of its key missions. Their efforts at monitoring Swedish forests for abundances of several highly damaging insect pests have been ambitious and have been conducted over several decades. Although the long-term nature of their FOMA assignment might be viewed only as a quantitative measure of its utility, this variety of successful long-term monitoring projects is literally a value-added endeavor. The quality of the results increases with every year, and interruption in this stream of continuous data would stop adding to its value to the scientific community and decrease the data's predictive abilities. This group of scientists has taken, processed, and analyzed spruce bark beetle and pine weevil samples from pheromone and other traps each year at four experimental forest sites in addition to many other sites. Exotic (invasive) species have also been monitored for and surveyed across these sites. Among other useful outcomes, the results of these studies have generated the design for a new control program for the spruce bark beetle, and the realization that damage levels in northern Sweden have been much higher than what had been previously assumed.

B 4. Actions for development at the Unit of Assessment

The Forest Entomology group's plans for the future are modest. At present, for some projects such as are related to their FOMA mission, they seem to be merely in a maintenance pattern,

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

wanting to hold on to what they've got and only to be able to continue these ongoing, ultra-long-term projects whose value increases each year of continuous monitoring. On the other hand, this group displayed some exciting new research results that could easily open up brand-new areas of inquiry of great interest to researchers in the forestry, the plant-plant communication, and the inducible plant defence fields alike. The key impediment to achieving success in both these areas involves the current absence of stable, "long-term" funding provided in at least 4 year intervals. In research, the current situation of uncertainty posed by year-to-year renewals prevents the taking on of PhD students, and this threatens the development of new young research talents who can take the research started by this group of senior researchers to new levels in the future. Invigoration of this highly productive and internationally recognized group with the addition of bright young PhD students would create a foundation for future success in forest entomology at SLU that is a key component in ensuring the future health and productivity of Swedish forests.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 632_1 Chemical Ecology

B 1. General assessment of the Unit of Assessment

Overall, this research unit is productive, highly respected internationally, balanced, and well-positioned. They are investigating a field of keen international interest that is widely recognized for its potential to both basic and applied science. The number of peer reviewed papers over the last five years has been very good for a unit of this size, built around its core of professors and senior staff (7 in total). Most of the peer-reviewed papers have been in well-recognized international journals, and the level of citation has been appropriate for journals of that stature. The group has been active in delivering scientific presentations, and highly sought after for invited talks. Graduate training has been solid, with 15 Ph.D.'s during the last 10 years, and currently there are 13 enrolled Ph.D. students.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The overarching theme has been the role of chemical signaling in insect behavior. The flow of publications has been steady, without any significant lapses over the last five years, or any evidence of 'boom-and-bust' erratic tendencies. There is a very good balance between research productivity at the suborganismal (neurophysiology, neuroanatomy) and behavioral (host choice, response to pheromones) levels. There appears to be relatively little work at the population, field, and landscape levels. Given the small number of senior researchers, we think the benefits of this focus outweigh the disadvantages of lost opportunities, at least in the short term. Most of the work has been basic rather than applied in nature, but the majority has been on insects of applied importance, thus keeping valuable relevance to the rationale of study organism selection. There has been a relatively even balance between insects affecting agriculture and forestry, with less on insects affecting human health. The unit has aimed for and is succeeding in publishing in respected international journals.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

It is clear from the steady stream of papers in high-quality journals that this unit is valued internationally as a reliable source of new and accurate information that will benefit the scientific community as a whole, as well as stakeholder groups. Compared to the benchmark institutions, this group equals many of them in that regard. However, some of the benchmark institutions may surpass this group in the more far-reaching, cutting-edge, and cross-cutting areas. For example, one cannot think of tritrophic interactions without thinking immediately of contributions from Wageningen, nor of elicitation pathways without thinking of the Max Planck Institute and Penn State, nor of chemoreception without thinking of UC-Riverside and Univ. Arizona. There is no equivalent area of stature for SLU. That said, however, SLU has shown very high balance and breadth as per comments in B2-1. So to some extent, this becomes a matter of internal choice on how to proceed with strategic planning, a choice which all institutions find extremely difficult. The unit appears to be thinking hard about the various trade-offs here, as reflected in some statements within their Self-Assessment.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The self-assessment as well as the interview provide several examples in which basic research has been applied to areas of forestry and agriculture, and in some cases these have achieved direct/immediate utility (3 patents, 1 license, 1 spin-off). The publication list provides several good field trial examples of using semiochemicals to control forest (Schlyter) and agricultural (Witzgall) pests, with promising potential. It is commendable that this group is also exploring using semiochemistry in novel ways, such as promoting biodiversity and conservation (Svensson et al. 2005), and for dealing with emerging issues such as rising CO₂ (Agrell et al. 2004, 2006). The establishment of the PheroList web page also stands out as a highlight. There has also been a healthy exchange of researchers from other institutions.

This work is of relevance to global, national and regional issues. Because most of the work from this unit is basic, it is also of international relevance to the scientific community. Scientists from all countries value the work from the SLU Chemical Ecology group. The work contains a mixture of short-term, medium-term, and long-term perspectives, with the majority on medium-term.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The current strategy seems solid and sustainable. The Chemical Ecology Group has a solid core of well-trained, motivated, productive scientists who will continue this unit's well-developed tradition of contributing on the international stage. The core of highly qualified and numerous technicians is enviable. The self-assessment states their equipment is second to

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

none, and this is confirmed in the oral presentation. The issue of gender balance is a difficult one to assess: All of the full professors are male, as are most “researchers”. However, there is a much better gender balance among doctoral students. This is a common pattern among university departments everywhere, so the emphasis needs to be on the trajectory, which appears positive. A difficult decision will be whether to emphasize depth or breadth. The Chemical Ecology unit recognizes this, and is well aware that group size is both advantageous and demanding.

On the basis of this evaluation, award a score from 1-6 ⁴:

6

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

NA

B 4. Actions for development at the Unit of Assessment

Our recommendations for future actions would not be complete without first saying “Keep up the good work”. This is a highly productive, effective, and relevant unit. We cannot emphasize that enough. Also, it is always much easier for an evaluator to make recommendations than for people contending with local realities to implement them. It is never possible for an outsider to truly appreciate the conflicting demands, internal challenges, and financial constraints of another’s institution. That said, we have three suggestions that we hope are helpful:

1. Make fuller opportunities of interdisciplinary linkages. One strategy for doing this is through graduate students and postdoctoral associates, so this recommendation is intended to be integrated with recommendation number three below. The packet includes many examples of multi-authored papers, which is good. But there is potential for a more cross-cutting dimension, and this could help the unit in the long-run. The self-assessment points out that the age profile is advantageous in that ‘peak productivity’ is still ahead. But this age-structure also provides opportunities for entirely new linkages, directions and interactions in addition to productivity. Formulating projects around methodology, whether traditional or novel, can work against this.
2. Consider opportunities for establishing dominance in an emerging area as a way of avoiding harsh trade-offs between depth versus breadth. We suggest avoiding head-on competitions in areas where large established institutions already dominate, and instead exploring linkages in areas where multiple Fennoscandinavian institutions are leaders. Some examples might be biodiversity - conservation biology - population dynamics - landscape ecology, with an emphasis on how a better understanding of semiochemistry could advance them.
3. Improve the pipeline of young talent, and draw on the futuristic thinking and energy of young scientists. We have three specific suggestions: a) Develop a mentoring program for young faculty. By this we do not mean more supervision or direction of their research course. We mean sharing with them the accumulated wisdom of experienced careers, professional

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

insight, and historical legacy, as well as assistance in navigating sensitive political waters, and providing constructive critiques of progress; b) Engage undergraduates. We saw little evidence of involving undergraduates in independent research, nor of classroom instruction by full professors. This is a great source of future top-flight, independent graduate students; c) Promote the same level of continuity in graduate instruction that you have shown in research productivity and publication. We commend how this highly productive research unit has not suffered from "boom-and-bust" trends in publication. However the graduate program has shown such a trend. We realize that funding is a huge issue, but one strategy for addressing that is more interdisciplinary and inter-regional collaboration. That can help buffer against dips in a particular subdiscipline or institution.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 632_2 Integrated Plant Protection

B 1. General assessment of the Unit of Assessment

The panel observed in the written self-assessment and the personal interview with the unit leaders this group's dedication to their mission of exploring new ways to combine pest population suppression techniques to progress towards their stated goal of creating more resilient agroecosystems. This is moderate-to-small sized UoA that was newly formed in 2007 as part of the new Department of Plant Protection and is still in the very early stages of establishment. One could say that it is almost premature to perform an evaluation of their program at this stage, especially since they have been in a sort of limbo since 2007 while awaiting the 2009 arrival of a new appointee to fill the position of Professor of Plant Protection. Research in this UoA is focused on a wide variety of cropping systems on pest species that affect the agroecosystem's below-ground interspecific communication dynamics as well as the above-ground population dynamics of pest-beneficial insect communities. Research is highly field oriented in order to attain realistic estimates of real-world effect that involve natural interactions among individuals of a wide variety of species. This group has not been highly productive with regard to publishing in peer-reviewed scientific journals, as is evidenced in the bibliometric analyses that were provided to us. They have published a significant number of reports and articles in popular science magazines. This group has articulated no clear concept as what their future, sustainable research thrusts might be that will give them a degree of independence from reacting to short-term needs of commodity groups and the short-term funds that accompany them.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The Integrated Plant Protection UoA has performed considerable research on difficult real-world field problems. This research may have resulted in progress towards their goal of more resilient agroecosystems, but this is not reflected in the peer-reviewed publication record or any of the parameters comprising their bibliometric analysis results. It was unclear to this panel that their remit was to accomplish innovative new research appropriate to peer-reviewed journals. Instead, we gained the impression that their remit was to assure users of the validity of available products and technologies.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The panel concluded that the remit of this very recently formed and very small group is not completely developed, but that their previous responsibilities were to demonstrate available technologies to users in Sweden. We also concluded that investigation of mechanisms to incorporate globally available products and technologies into Swedish agriculture has been an important charge to the group (perhaps carried over from previous responsibilities in previous administrative structures). In this case we understand that international recognition and global leadership would not be an expectation. We gained the distinct impression that the group is good at what it does/did.

On the basis of this evaluation, award a score from 1-6 ²:

3

3. Relevance and Impact

We conclude that practitioners in traditional and organic agriculture are appreciative of the accomplishments of this group. We believe that data from the field tests are used by the several diverse communities served by this group. We think these types of evaluations are much appreciated by the local communities and we agree that they are very important. This is a new group established 2007. They work on a participatory base with extension service and the farmers and have published 22 articles in popular science magazines. They have evaluated decision support systems for early and late blight and nematodes that have potential to reduce pesticides use in potato crops. Minimizing use of pesticides is included in the Swedish Environmental Quality goals. They run the only nematode laboratories within the Nordic countries. The importance of IPM will increase due to a new EU legislation on Sustainable use of pesticides stating that IPM will be obligatory to use after 2014. They are also working with support from SIDA with nematodes in Nicaragua.

It appears from the materials we received and from the interview that the audience for the data from this group is local or perhaps regional and that the data are of immediate impact. Whether the results are also medium or long term is currently unknown.

On the basis of this evaluation, award a score from 1-6 ³:

5

4. Strategy and Potential

It is premature to assess or comment on the strategy and potential of the group. They are currently awaiting the appointment of a recruited professor and their expectation is that strategy will be developed and implemented after this important appointment. However, the very basic components of the activities of the group are expected to remain. We agree that field evaluations of technologies and products for commercial and organic farmers in Sweden are important and needs to be continued.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

N/A

B 4. Actions for development at the Unit of Assessment

The integrated plant protection U of A has apparently been in a holding pattern since the reorganization that has occurred in 2007. Their relatively modest scientific productivity has been impacted by their perception that they need guidance and leadership, which is now nearly here with the hiring of a professor for this group and the resistance biology group. During this lull in scientific output, the integrated plant protection U of A has been diligent in delivering information to end-users concerning organic practices and integrated pest management, including methods for enhancing biological control. This group will benefit from any vision and innovation that will be provided, hopefully, by the new professorship.

B 5. Additional information

It is clear that this group would benefit from some institutional stability. They are a newly formed group in a newly formed department, and without a recruited professor. The panel is struck by the degree of change that has occurred at SLU over the past few years. Some groups have been successful and have not changed much during this period of change, but other groups have been noticeably affected and restructured. The panel hopes that the current structure is successful remains in place so that the smaller UoA's can concentrate on accomplishment.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 10. Plant Protection

Unit of Assessment: 632_3 Resistance Biology

B 1. General assessment of the Unit of Assessment

This unit of Assessment is in major transition so it seems almost inappropriate to provide detailed comment. It is a very new group in a new department. There is not yet a professor to lead the group. The direction of the unit will develop with the appointment of the new recruited professor. We understand that the recruitment is in process, but we do not know the directions, and we assume that it will subject to dramatic change in the next years. Previous accomplishment has occurred in a diversity of areas, not just in resistance biology. In terms of resistance biology, the group has made some interesting discoveries, but the next steps seem to be technically challenging and may require the expertise of the new professor or perhaps collaboration with groups with molecular biology expertise. The inclusion of electron microscopy seems to be a service function as much as an intentional tool for use in appropriate investigation. Other units appreciated the availability of this service and were strongly supportive. However, we were unclear if the support of the electron microscopy function was sustainable.

The unit is tiny with distinctly diverse projects on three hosts. It was difficult for the panel to identify a cohesive resistance theme running through the projects. The projects were induced resistance in potatoes to *P. infestans*, field resistance in potatoes to *P. infestans*, defense mechanisms in barley, and resistance in coffee to *Colletotrichum*. The apparent absence of a cohesive theme seemed to act against the probability of developing an international reputation, and the lack of molecular genetic approaches makes this program an outlier in the field at large.

The group is certainly willing to collaborate with diverse groups and to provide electron microscopy expertise when desired.

The segregation of this unit away from other units in the newly formed Department of Plant Protection Biology may have impeded the ability of the panel to understand the degree of interactions occurring within the UoA.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Because the unit is clearly in transition, and because the group has been without a recruited professor its emphasis has been somewhat diffuse. There is a diversity of accomplishments, but not all have received sufficient publicity or application. The group is international in scope, working on projects that have application in Sweden and in Viet Nam. There appear to

be appropriate collaborations with plant breeders at SLU. The exemplar papers listed in the self evaluation were not placed in particularly high quality journals.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The unit is not now an international leader in issues concerning plant resistance. Certainly the accomplishments are consistent with those in other groups around the world, but the unit is too small to compete at the leading edge, and the tools used are dated. Questions being asked are somewhat similar to those being asked in other systems, but the human and technical resources for pursuing the next steps are not currently in place.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The development of techniques to enhance or induce late blight resistance in potatoes could help the development of sustainable potato production. However, there are many unknowns before this goal is achievable. The investigations of *PR5* in transgenic barley may lead to resistant barley, and if so would have high relevance and significant impact. However, this work is still high risk – not guaranteed to work in commercial application. In association with the study of resistance in coffee is the possibility that there is significant diversity in the *Colletotrichum* population. This pathosystem could lead to interesting discoveries about the evolution of pathogenicity. However, a significant amount of additional background is required to be able to address those interesting basic questions.

The work done in this UoA is currently limited in impact. Practical local success with enhanced or induced resistance in potato to late blight will certainly have impact in Sweden, but the demonstration would generate interest and activity worldwide. Demonstration of significant transgenic resistance in barley via *PR5* would also have implication worldwide and perhaps for the long term. New insight to pathogenicity in *Colletotrichum* has the potential to inform investigations worldwide on host-pathogen interactions. However, this work is still in its infancy.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

It is very difficult for the panel to comment on the strategy and potential of the UoA, because we perceive that it is very much in transition and the directions could change dramatically in

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

the next 12 months. All of the projects offer interesting possibility, but none has yet developed to the point of being internationally recognized. We perceived that the members of the UoA were awaiting the arrival of the new professor and the absence of a professor has been a handicap for the group. We agree that host resistance is an important area of study, but if that is to continue as a main thrust, there needs to be additional effort to tie the components together into a viable, cohesive, visible and competitive thrust. In addition to join the mainstream of field of resistance biology molecular genetic tools must be employed.

We agree with the UoA that their very small size, small number of Ph.D. students, absence of a professorship and the diversion of energies by the senior academic to other service duties are significant impediments.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA does not seem to have FOMA responsibilities.

B 4. Actions for development at the Unit of Assessment

The most important development will be the recruitment of a professor. The unit is severely hampered by its small size. A new professor is needed to aid the growth of the group. There should be a cohesive theme linking the various activities, so the unit can gain a reputation in plant resistance. Most activities appear so challenging that visible success will be difficult. It will be important to build a program of activity so that the basic studies in the group can be linked to the more practical studies, and vice versa. Success (implementation of result or change in practice because of research accomplishment) in very practical projects is very difficult. It is important that the basic projects in the UoA have relationship to the more practical projects so that the entire unit can be recognized for any accomplishment – basic or applied.

B 5. Additional information

If SLU wishes to have a place at the table in terms of induced resistance, transgenic resistance, or integrated control, there needs to be interaction between the “Resistance Biology” group and other persons with complementary expertise. At the moment the group is too small to have a major impact.

Some stability of administrative structure would be beneficial to this group in particular. The panel feels that the several recent changes have created instability and that persons in very tiny groups such as “Resistance Biology” have been especially vulnerable.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 11. Plant Production

The scores for the panel averaged over the nine UoA's were:

Scientific Quality: 3.7 (Moderate to internationally recognised)

Recognition and Leadership: 3.7 (Moderate to good)

Relevance and Impact: 3.7 (Moderate to high importance)

Strategy and Potential: 2.8 (Inadequate to good)

The panel noted that this was not a complete view of SLU's involvement in Plant Production, particularly as UoA 634_1 had not been included in its portfolio.

The panel considered that the funding model of the SLU was unique in their experience. The need to fund so much of senior staff out of soft-moneys had highly significant impacts upon the strategy, performance and management of research. Many of the UoA's are driven by perceptions of potential funding streams and this has often led to an apparent desire to develop niche areas of expertise, rather than critical mass and long term, sustainable research programmes. The funding model appears to generate excessive competition between researchers from different research groups within the SLU working on similar problems, and that this could be seen as inefficient and counter to potential benefits for collaboration. For example, the Crop Science, Crop Physiology and Cropping Systems groups had similar interests and could be more effective, particularly in achieving world recognition, if they had more collaboration and combined strategic management. It is very important that communication takes place within and between groups so that UoA's could coalesce around clear visions, common goals, research themes, and ultimately well articulated strategies. The short term funding imperative also appeared to have contributed to a lack of real engagement in addressing major areas where Sweden had potential competitive advantage. Such areas included Plant Production impacts of and on climate change, and the need to improve carbon and nutrient balances.

It appears to the Panel that there is a dynamic at work at the SLU that research in general is transitioning to greater emphasis on more fundamental research, and a decreased emphasis on applied, extension-focussed research. This may be driven from a strategic point of view, but may also be a reality in terms of accessing research funding in an ever-growing competitive environment. Some members play important roles in extension and outreach activities to stake-holder groups. This was considered appropriate activity for an Agricultural University, but the Panel did not feel that extension activities excluded the need to publish the results of applied research in the scientific literature.

The Panel recognised world class research in a number of UoA's, but further progress requires greater utilization of modern research techniques and platforms. In this subject area there was less exploitation of process-based modelling, molecular techniques, and other systems biology approaches that would have been expected in a world-leading institution.

The panel considered that lack of permanent funding from SLU to all units is a significant detriment to the development, stability and productivity of all research groups. The university (and wider government structures) should reconsider the funding approach and work on mechanisms of providing more stability. There seems to be a sense of demoralization pervading all groups, and this is directly related to the lack of stable funding even for salaries. The panel questions whether SLU can improve its world - ranking in plant production research with its current funding approaches.

The significance of the UoA structure was not always clear. Some UoA's seemed only to have been configured to submit to this evaluation, whilst others had had a clear, long-established identity. It was notable that highest scores for strategy were achieved by UoA's developed by single researchers. It is perhaps unfair to expect clear strategic plans to have been developed by collections of individuals that have only recently been brought together.

The representatives of the stakeholders on the panel saw Plant Production is one of the cores of SLU, representing a crucial part of agriculture of great importance for SLU as a sector university. The field of research has changed from the former organization of different divisions of applied research based on field experiments towards more basic research. This transition period seems to be ongoing since many UoA's have difficulties in seeing themselves as responsible both for out-reach activities and basic research. The panel's stakeholder representatives expected SLU and particularly the field of plant production to take strategic responsibility for research programs in climate change impacts on agriculture, and developing an environmentally and economically sustainable industry. The stakeholder representatives felt strongly that the most successful UoA's were those conducting basic as well as applied research, and that it is an imperative to involve the stakeholders in identifying research areas to find the most relevant questions. Stakeholders expected research to be conducted on the economically important crops in Sweden so that the education programmes at SLU will provide expertise ready to meet the needs of future agricultural conditions.

Part B: Report on individual Unit of Assessment

Panel 11. Plant production

Unit of Assessment: 500_1 Ecology of Cultivation Systems

B 1. General assessment of the Unit of Assessment

The UoA is dealing with studies on sustainable crop production systems. The research includes interactions between plant, soil, environmental factors, and cultivation and management practices applying a system approach based on empirical data and integrated process-based simulation models. The research profile is quite broad regarding the plants considered in field experiments, but depth is also evident, particularly with respect to the modeling techniques employed. New methodological approaches are going to be introduced like remote sensing, which allows a perspective to bridge the gap from the field and farm scale to landscape in the medium term. The group is performing better than the average of groups in nearby UoA's in terms of scientific quality, and leadership and impact. The cooperation network with related disciplines within SLU as well as with groups outside SLU is evident. There are strong synergies documented between research and environmental monitoring and assessment (FOMA). The panel gives some comments regarding strategy and potential, and recommends a strengthening of the modeling activities as a central element of integrated farming system analysis research.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA documents convincing records regarding originality of ideas mainly purposed for model development. The experimental program therefore is dedicated to generate parameter data relevant for modeling crop growth and crop rotation systems like solar radiation use efficiency, water use efficiency and others. Overall the experimental program is quite broad including different crops (ley systems, cereals) and covering aspects of related fields like weed ecology, plant protection, plant nutrition, product quality and soil science, but due to the close cooperation with other groups of the department that's not a disadvantage. Models then serve as a tool for system analysis, which is an appropriate methodological approach.

Scientific productivity is convincing in terms of number and quality of publications in peer reviewed journals. However, the panel found significant differences in publication performance within the group of senior scientists/professors. While Eckersten performs very well and can underline the cooperation networks by the nominated co- authors in the papers, other senior scientists are less productive. The panel appreciated that the above mentioned performance was realized in spite of a vacant professor position over all the years recorded in the self-assessment. Considering these circumstances, the number of PhD exams, as well as the external grants of the group are impressive.

Ingrid Öborn was recently appointed for the above mentioned vacant professor position, and her number of papers and recognition of journals are appropriate.

Regarding impact and prominence of the scientific work, the benchmarking groups, mentioned by the UoA, are a good indicator. Compared to these the UoA performs very well, attaining international recognition and prominence especially in the northern European scientific environment.

The niche of the UoA pronounced in the self-assessment claims a “coordination position for SLU crop research”, which unfortunately was not appreciated in this clarity by the other groups of the department.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Due to the short time of IÖ being head of the group the recognition and leadership is related mainly to the topics of HE, who is well known in the scientific modelling community worldwide and has documented leadership in that field at least in northern European agronomy contingent. On the national scale he can document this leadership in terms of modelling climate change scenarios for Swedish agriculture, which is without doubt of great relevance for the society. Appropriate model networking with groups in neighbour countries is to be seen in the records.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

It is evident that the UoA informs policy development in areas of climate change impacts, sustainable agriculture, and new production systems (e.g. derived from on the FANFAN project). The panel does expect that due to these established pathways to politicians and stakeholders, the UoA will also contribute in the future for a sustainable development of society, agricultural practise and industry.

The main focus is the national scale, but with some relevance also for the Nordic countries. Regarding the time dimension, the subject (climate change and agricultural systems), as well as the methods (long term experiments-modeling), result in a long term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

There is a significant difference between the self-assessment documentation (presumably

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

compiled before Öborn was appointed to the professorship) and what was presented orally to the panel with regards the topics covered by the UoA. Topics given in the oral presentation were quite general and not really informative, e.g. “development of systems level research”. The application for an integrated research project consisting of 45 research groups was announced (Effects of climate change...) with 2 groups from the UoA. Additionally some other applications highlight topics like NUE/WUE of biomass production or remote sensing tools for modelling climate change scenarios on crop production. Unfortunately the information is too sparse to recognize a real focussed strategy. We miss the coordination role of the group as claimed in the self assessment. We miss also the dominant role of modelling as the central methodological tool of research in this UoA.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The group has a significant role in running central climatic stations relevant for FOMA.

B 4. Actions for development at the Unit of Assessment

The panel suggests that the UoA explores the possibilities of expanding its modelling approaches (including the potential for a faculty professorship), and therefore develop a more integrative platform for crop production and farming systems research at SLU. The panel also perceives that the UoA could coordinate research work with other groups in and beyond the department to derive a gradient of climatic environments, necessary for successful modelling work.

The panel considers that the cropping system can not be seen in isolation from the farming system and therefore effective networking with UoA's beyond the remit of this panel is encouraged.

B 5. Additional information

SLU should consider a reconstruction of the groups in the crops area to provide more integrative and synergistic collaboration (particularly amongst the Crop Science, Crop Physiology, Cultivation Systems and Short Rotation Forestry groups). The impression of the panel is that Cultivation Systems are particularly well-placed to provide integrative leadership in this area due to the nature and potential of the modelling work. SLU is encouraged to explore this further.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 11. Plant Production

Unit of Assessment: 500_2 Crop Physiology

B 1. General assessment of the Unit of Assessment

The Crop Physiology UoA does wide-ranging research in growth, development and production in a few, but diverse crops (e.g. grassland species, potatoes, Salix). The UoA is a medium-sized group composed of 1 professor, 4 senior researchers, 1 junior researcher, 2 PhD students and 1 other staff member constituting 6.15 FTE devoted to research. The Panel was also informed at the interview with members of the UoA that a new Junior Research and PhD student has recently joined or are to join the group. The Crop Physiology group acquires a very good level of funding of approximately 9MSEK per year with the vast majority (approx. 80%) coming from external sources and the largest contributor being Swedish Public authorities. Publishing in the scientific literature is highly variable amongst the members of the UoA (see section B2). Some members play important roles in extension and outreach activities to stake-holder groups.

Situated in Dept. of Crop Production Ecology the UoA has access to a large array of facilities for plant and crop testing under controlled-environment and field conditions. While a diverse group, it seems that there has not been much interdisciplinary research to date between or among the members of the UoA. In some cases, the opportunities for collaborative research are better situated with other UoA's (e.g. Cropping Systems, Crop Science, Short Rotation Forestry) than within the Crop Physiology UoA itself.

It seems that the UoA has only recently been organized as a unit and this has presented some challenges for the group to present as an integrated unit for this review process. This has also presented a challenge for the Review Panel as Dr. Weih's significant productivity is reported within this group, but from activities largely executed from his former work with the Short Rotation Forestry group. Indeed, the outputs of this individual are double-counted across the two UoA's.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Research productivity of the UoA in the form of peer-reviewed articles varies greatly, with one member being highly productive, another with a reasonable number (~5) over the assessment period, and others with few to none. Most of these publications are in internationally recognized journals appropriate for the subject areas, and some with high levels of impact (e.g. Theoretical and Applied Genetics) and others with reasonable levels of impact for the field (e.g. New Phytologist, Oecologia, and Crop Science). However, as a group, the bibliometric data indicates below average performance. It is interesting to note that the greatest productivity and impact is by the newest member to join the unit and without that member's contribution, the impact factor of the group would be very low. One reason for the low productivity by some members of the UoA given during the interview was that they were

more involved in applied research and research contributions were disseminated by courses and reports to farmers and industry. This was recognized by the Review Panel, but they did not feel that this excluded the need to publish the results of applied research in the scientific literature.

Aside from the very good to excellent research in the Salix area, other publications, while meritorious, were not seen as particularly innovative. The Panel noted that the paper published in *J Ecol* 2007 is a major contribution; however, the UoA appears to have played a supportive (and not lead) role in this very large study.

The group has been involved in a reasonable number of national and EU supported major initiatives especially in the forage and bioenergy areas. The UoA has only awarded 3 PhDs in the last 10 years, which was viewed as small by the Panel.

The Panel was challenged when it came to indicating a single numerical value on the Scientific Quality of the UoA because the group is relatively newly formed, and some members would fall into the High-international category (score 5) and others in the Inadequate categories (score 2). That being said, the Panel has assigned a rating of “4” (Internationally recognized) for the group, as an average, but note a wide range in research quality across the members of the group.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The members of the Crop Physiology UoA generally have a good level of leadership and recognition, and that these vary in terms of the communities in which they are primarily engaged (i.e. highly scientific to highly service-oriented). The potato research appears to be highly involved in extension service and appears well received by the receptor community. The forage research appears to span both the basic and applied research fields. The Salix research seems to be well recognized nationally and internationally.

The group has been invited to give oral presentations and help organize numerous national and international conferences and this is laudable. One member of the UoA has an academic fellowship, but no awards or prizes are listed for the members for the assessment period. The UoA currently only has two PhD students, which is modest for the size of the group, and no post-doctoral fellows. Members of the UoA have been involved in activities in a number of developing countries, mainly in the roles of assistant supervisors of PhD students.

As with the Scientific Quality, there is great range within the UoA in terms of the ability to lead the scientific debate in their fields (i.e. the potato research little so, the forage research moderately so, and the Salix research highly so).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The applied research aspects of the UoA's activities appear to have quite high relevance and reasonable impact for receptor groups. As noted above, the majority of funding for the Crop Physiology group comes from the Swedish Public authorities and there is extensive extension and outreach activity by some of the members of the UoA. A major role of the “Research

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

Secretary” appears to be to communicate information to receptor communities. The panel was told of courses and meetings also provided to agronomic specialists and consultants in the community. As noted above, this extension work is laudable, but the Panel feels that this research should be carried out at an acceptable quality and with the additional effort to ensure that the results of this research are published in the scientific literature.

Given that the physiology of crops is highly influenced by the edaphic and climatic conditions of where they are grown, this sort of research is a highly geographically sensitive. That being said, there are probably greater opportunities for the UoA to collaborate with the Crop Science UoA in Umea and other agronomically-oriented researchers in Nordic environments.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

By the UoA's own admission, there is not a clear strategic plan in place for the group. This is apparently due to the recent identification of the UoA and the addition of an important member to the team. As identified in the UoA, it is very important that communication take place within the group and with others so that the UoA can coalesce around a clear vision, common goals, research themes and ultimately a well articulated strategic plan.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable.

B 4. Actions for development at the Unit of Assessment

As noted above, it is very important that the UoA develops a strategic plan for moving forward as an integrated unit. In the development of this plan, the Panel encourages the UoA to take the following factors and issues into account:

- The needs of the agricultural community (i.e. the need for research on the physiology of agronomically and economically important crops to the region, particularly wheat and rapeseed .
- Research that addresses major aspects of our time on the development of crops research, particularly the influences of climate change and the need to decrease greenhouse gas emission from crop production.
- The opportunities for greater collaboration and synergy with the Crop Science and Cropping System UoA's.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

It appears to the Panel that there is a dynamic at work at the SLU that research in general is transitioning to greater emphasis on more fundamental, basic research, and a decreased emphasis on applied, extension-focussed research. This may be driven from a strategic point of view, but may also be a reality in terms of accessing research funding in an ever-growing competitive environment. The Crop Physiology UoA may be more impacted by this transition than others and therefore needs to be adaptable and responsive to these changes.

Part B: Report on individual Unit of Assessment

Plant 11. Plant Production

Unit of Assessment: 500_3 Short Rotation Forestry

B 1. General assessment of the Unit of Assessment

This group was mostly concerned with the physiology and production technology of deciduous trees (mostly willow [*Salix*]) for energy purposes. The group was originally part of a Forestry Department and had been formed when there was an optimistic outlook for the demand and production of willow in Sweden. There had been activity in: environmental impact and applications of willow production; stand establishment and ecology; and ecophysiology. The physiology capability of the group had been significantly weakened since one senior member, with associated support staff, had transferred to the Crop Physiology Group with a remit to further understanding in arable crops. Remaining research in the group was highly applied and/or policy oriented, and funded not from research council monies, but mostly through public authorities in Sweden. Despite the applied nature of the research, there was an acknowledged low level of uptake of information generated from the group, by the production industry. The reasons for this reduced impact on the producers had been studied and were thought to be due to socio-economic factors. Far less willow had been planted than had been anticipated by commentators and opinion formers a decade ago.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

It was difficult to assess the metrics of this group as much of the output had been associated with three members that had already been moved to Crop Physiology, and had also been counted there i.e. there was double accounting within the submissions to the panel.

The group had been prolific in good quality scientific journals for this field of study. Many of the quality papers were authored by the individuals now contributing to the Crop Physiology Group, although remaining members of Short Rotation Forestry had also demonstrated good quality authorship. Recent grant monies had not derived from research councils, although applications were pending. Numbers of PhDs awarded was comparatively high, and there was evidence of national and international collaboration with well regarded partners.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The group had received a large number of invitations to present at international conferences and played significant roles on intergovernmental (FAO, IEA), and governmental committees. No awards or society memberships were listed, but there was good evidence that the group contributed to policy forming processes, particularly (but not exclusively) in the Nordic region. The current research environment remains to be clarified. The move out of the Forestry Department has presented significant challenges and the recent departure of significant members to the Crop Physiology Group raises concerns about the long-term viability of this UoA.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group stated that they integrated knowledge of traits relevant to bio-energy production from woody species, to inform breeding programmes. Specific examples of where this integration had occurred were not presented, and delivery of such integration, for example in the provision and use of QTLs, pre-breeding germplasm, and molecular markers remained an aspiration. Although there was relatively little area of willow production in Sweden (14K ha), quality of the production process varied greatly. A few 'lead' producers may have exploited some of the information generated by the UoA, but there was a long 'tail' of poorer production, dissatisfaction with the crop amongst growers, and an acknowledged poor uptake of knowledge. Nonetheless, other societal impacts were being made via the energy authorities and companies. Willow, as well as producing bio-energy, had further benefits including: buffering water catchments from leachate; and acting as a safer recipient of sewage sludge compared to food crops.

Willow production has failed to expand on the timescale originally envisaged. There is concern as to whether short rotation forestry has particular competitive advantage in Sweden, not least because of other competing sources of non-fossil energy (residues from long term forestry; hydro-electrics etc). Future expansion of willow would likely require changes in subsidies and costs for other land-uses and energy sources that are difficult to predict. In an uncertain world, encouraging arable farmers to invest significant land parcels in a crop for 20 years is likely to remain a significant challenge.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

As stated above, there are significant concerns about the long term viability of this group. There are synergies of this group with those working with other annual and perennial crops, and knowledge of crop physiology and associated methodology is transferable. This is both a threat (i.e. it is possible for the group to be redistributed, as has partially happened) as well as

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³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

an opportunity for wider collaboration. With the current limited resources for faculty funded positions it is likely that short rotation forestry will increasingly struggle to justify its position.

On the basis of this evaluation, award a score from 1-6 ⁴:

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

As stated above, a possible way forward is to apply knowledge and methodology to a wider set of crops.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 11. Plant Production

Unit of Assessment: 500_4 Weed Biology and Management

B 1. General assessment of the Unit of Assessment

The overall goals of the Weed Biology and Management Unit are to develop means of controlling weed populations impacting agricultural production and to gain fundamental knowledge of the basic biology of weed species and populations. On the one hand, the group is highly focused on the specific area of weed biology and control. Within this area, however, the group addresses a broad range of research topics, including, but not limited to: organic management practices for weed control, herbicide resistance in weeds, biological mechanisms of dormancy and its relation to weed population structure, and weed/crop interactions. The UoA, however, does seem to lack multi- and interdisciplinary activities, and the expertise (such as modeling) that would support better integration. There was no synergy indicated with FOMA; this situation should be addressed, as this group should take steps to incorporate climatic data in their investigations. There were no linkages indicated with other UoA's.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The group conducts a number of experiments that could have impact on production practices within Sweden. They have established cooperative projects with additional European researchers, including scientists based at Aarhus University Denmark, Copenhagen University Denmark, MTT Agrifood Research Finland, Norwegian University of Life Sciences, Wageningen University Netherlands, Scottish Agricultural College and Rothamsted Research England. Within Sweden there are also partnerships with the Swedish Rural Economy and Agricultural Societies. Productivity by some members of the group is good, with a steady stream of publications in a number of respected journals. However, publication does not seem to be evenly distributed, with some members responsible for many contributions, and some responsible for not so many. Also, many of the publications have been contributed by a “guest professor”. Much of the research still utilizes rather classical methods of investigation, and the selected range of topics of investigation seems narrow. This is an area that would be ripe for investigations incorporating molecular approaches. Some steps have been taken in this direction (e.g. the paper “Genetic variability and genomic divergence of *Elymus repens* and related species”), but the researchers should have been encouraged to incorporate molecular approaches into their investigations in seed dormancy, weed genetic diversity and herbicide tolerance. This is especially important in the area of seed dormancy, which the group cites often in its list of significant recent accomplishments.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

Recent scientific leadership by the most senior member of the group did not appear particularly effective. This individual has produced little in the way of publication over the past 5 years. The group has received relatively few invitations to speak at scientific conferences. The number of major contracts with public authorities and industry is limited. International recognition is low, with only one member of the group currently having an editing position with a scientific journal. In the absence of strong leadership from the most senior member, other group members need to be encouraged to assume leadership roles. The UoA, however, should be well positioned to comment on the effectiveness of controlling weeds with non-chemical approaches. This could become especially important in Sweden, if there is a political imperative to reduce chemical methods of weed control. In such a scenario the unit does have potential to become a world leader in the area of non-chemical means of control. The unit is well positioned to investigate the effects of climate change on weed populations, another area in which they could take a lead. Funding levels seem to be adequate but nearly all of the funding is derived from one source (Formas).

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

From the evidence presented, the unit appears capable of developing effective educational tools for weed identification and control, and these could serve as models for weed control programs around the world. As noted above, this unit is well positioned to generate knowledge that will contribute to sustainable and environmentally friendly methods of weed control. Some members of the review panel question whether this group has impacted farming practices to the extent that, based on their area of investigation, that they should have. The group should perhaps self-examine this topic and determine if steps are to be taken to improve this situation.

To date, much of the impact has been local (within Sweden). This has occurred through the development of the "Weed Advisor" program. The long-term potential for this group to have international impact is good. As noted above, the group can become a world leader in non-chemical methods of weed control, and in the impact of climate change on weed populations. The group, however, needs to seize the opportunities it has been presented with, and some of the more junior members need to assume leadership roles.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Only two PhD students have completed degrees in the past 10 years. However, the group seems to be addressing this topic and now has several students enrolled in PhD programs. Thus, there seems to be potential for the development of new faculty members. Future research potential may depend upon the ability of the group to incorporate new research

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³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

approaches, especially as younger scientists are keen to learn these techniques, and indeed, their future success may depend upon their expertise in this area. Climate change is very likely to impact the weed flora of Sweden, and this group is uniquely positioned to take advantage of this change and generate knowledge of world-wide interest. The unit needs to demonstrate that their traditional approaches and areas of investigation (e.g. dormancy responses) can translate into new methods and approaches for weed control. The group needs to establish synergies with other UoA's. There was little indication of any such attempts, and it will be especially critical to the successful incorporation of molecular techniques. Most of the goals listed in the strategy section of the self-assessment were administrative. The only scientific goal given was the establishment of long-term research plots, but the group neglected to mention the intent of these plots. It is difficult to assess the long-term scientific strategy if no scientific goals are listed.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Not applicable

B 4. Actions for development at the Unit of Assessment

This group needs to:

1. Exploit data generated from climate centres and crop planting surveys and develop predictive models for changes in the weed flora of Sweden in close cooperation with the modelling sub-group of the Cropping Systems UoA. They can then investigate and distribute information on means of control of new weeds.
2. Introduce some molecular biology tools into their methodologies. Recruit a molecular biologist to study mechanisms of weed seed dormancy. This could have spin-offs if the information is relevant to the topic of preharvest sprouting in cereals. The use of molecular markers would facilitate the investigation of genetic diversity in weed populations.

B 5. Additional information

The group faces some challenges in the future as they are being forced to relocate their research projects away from campus. This will be a significant detriment to workers, especially PhD students.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 11. Plant production

Unit of Assessment: 540_2 Crop Science

B 1. General assessment of the Unit of Assessment

This UoA formed about half of the Department of Agricultural Research for Northern Sweden. The principal aim was stated to be research underpinning sustainable production of high quality forage (particularly as related to cell wall chemistry) for milk production. However, other crops commonly seen in rotation with grass + legume forage, such as seed potatoes and barley were also studied. Key aspects of the system were seen to be the nitrogen (particularly fixation and nutrition) and carbon (particularly sequestration) cycles.

Other aspects already, or planned to be, studied included: biodiversity and ecosystem processes; bio-energy crops; endophytic fungi in forage grasses; and biological control of pathogens in potato and clover. Levels of investigation were said to extend from the molecular to the ecosystem.

The UoA comprised relatively few senior posts; two professors, one of which was heavily involved in administration, and would be retiring shortly. There was a high risk that the range of subjects was too broad, and detracted from achieving the principal aim.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Research appeared to have been conducted competently, with appropriate methods for field crop experimentation. Detailed chemical, biochemical and molecular analyses required facilities in other departments, in and beyond Sweden. The best work had been published in well regarded journals, appropriate to the subject. However, it was considered that, although often of an international standard, much of the work was incremental in nature, and may well be surpassed in the medium term. Competitive advantage for the work derived from the UoA's location, i.e. performance and processes at high latitudes, rather than because major advances in understanding of underlying processes, or methodology had been achieved.

The papers regarded as the best, by the members of the UoA included those where they were only one of many equal partners. Nonetheless, collaborative partners were of good academic standing in Sweden, and elsewhere. The panel felt that the links with other groups were appropriate for a nationally important programme in this subject area.

The number of PhD awards was considered moderate by the panel. Other external research funding, usually above 6MSEK, mostly from Research Councils and Foundations was significant.

A number of papers (by L Ericson) had been mis-appropriated to Crop Science and this increased the difficulty in interpreting the bibliometrics. Members of the UoA were not particularly prolific in the scientific literature.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Appropriate scientific leadership was evident, and the group contributed to a number of national and international programmes, often as coordinator. No major prizes or awards are reported. The authors are members of suitable societies and undertake duties of editorial and review commensurate with normal academic activities. PhD + Post-Docs currently totalled 5, which was considered moderate by the panel.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

There were a number of programmes funded by non-academic authorities, with significant monies coming from County Administration Boards

This UoA was important for investigating production techniques relevant to the north. There were a number of outreach and extension activities and collaborations, and meaningful links with relevant industrial partners in the region.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The panel felt that, for the size of group, activities and proposed activities were too broad, and not focussed on the principal aim. Diversity was driven by curiosity, perceptions of potential funding streams, and an apparent desire to develop niche areas of expertise. This approach was understandable given the reliance on soft monies to fund key researchers within the group but there was a significant threat of expertise and capacity being spread too thinly. The panel considered that more research could directly concern dairy and forage production in the north, particularly by using the special qualities of the location possibly to explore for example: climate change impacts; quantifying and reducing the carbon footprint of milk production; and the use of modelling techniques. The panel considered that the latter could be achieved with closer cooperation with the modelling group in Cropping Systems in Ultuna. The expertise in forage quality in Umea could be used to develop a better understanding of carbon

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

and nitrogen kinetics in the rumen with respect to differing forage qualities. The group had further potential to exploit linkages in its new location on the university campus, and also from within and outside SLU and Sweden.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

This unit should consider focusing their research efforts to fewer objectives. The unit might wish to consider developing two areas of emphasis, one of a practical nature, one of a more basic nature. This will allow impact at the local level, but also secure more of an international reputation. In addition, it will improve the chances for funding success. Finally, a replacement for L. Ericson, formerly a key component of this group, needs to be secured.

B 5. Additional information

The nature of the funding model appeared to generate excessive competition between researchers from within SLU working on similar problems, and that this could be seen as inefficient and counter to potential benefits for collaboration and achieving critical mass. For example in this case it seems obvious that the link between forage science and animal science (ruminant nutrition) is a topic which is relevant in Umea and in Ultuna indicating potential synergies for closer cooperation between these two groups.

⁴ The UoA's strategy and potential is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 11. Plant Production

Unit of Assessment: 633_1 Microbial Horticulture

B 1. General assessment of the Unit of Assessment

The Microbial Horticulture UoA is a small but very productive group working in niche areas to further sustainability in hydroponic greenhouse systems. Recently the UoA has moved into the research area of human pathogens in the production chain of certain horticultural crops. The UoA currently has a Professor, two Junior Researchers and three PhD students constituting 4.5 FTEs in research. The Unit acquires a good amount of funding for the size of the group at approximately \$3MSEK per year, awarded from research councils, foundations and industry. The group is productive in terms of publications in peer-reviewed scientific literature, but also contributes significantly to extension-oriented publications for the greenhouse-horticultural sector.

Situated in the Department of Landscape Planning, Horticulture and Agricultural Sciences at Alnarp, the UoA has opportunities for collaboration and consultation with others including members of the Horticulture Production Physiology grouping, and the Horticulture Quality and Post-harvest UoA. The UoA has access to standard microbiology and controlled-environment facilities necessary to carry out its work.

In general, the Panel was impressed with the innovation, productivity and potential of the UoA, and with the leadership of Dr. Alsanius in the group.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The Microbial Horticulture UoA has been productive in both the realms of peer-reviewed scientific papers and extension-oriented publications. Scientific papers are published in international journals relevant to the subject matter and, for the most part, with medium to high impact ratings for their fields. The bibliometric analysis, as presented, did not reflect the quality of the publications as judged by the panel. The panel was impressed that the research generated in the UoA was not only published in good journals, but also where applicable was “translated” into extension information which could be used by stakeholders. The Panel agreed with the claims of the UoA on the significance of the findings that phenolics within hydroponic solutions did not represent a significant negative impact on production when present at concentrations routinely observed in commercial practice.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The group secured significant monies from FORMAS, and had formed a graduate school. There was also evidence of co-ordinating and developing networks. The panel considered that the UoA was making a significant impact in a small field

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The panel considered that there was a good strategic plan and further potential to develop a centre of excellence in this field. Food-borne disease work has great potential and this is emerging.

The work has international and long-term application

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The panel felt that the strategy of the UoA was appropriate, and that there was good potential, albeit in a small field

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

It is likely that the linkages between the food chain and human health will continue to grow in significance. Work with human pathogens, or with microbes that impact on nutritional and toxicological aspects horticultural crops is a key area of potential expansion. At present the UoA is focussed on a defined area, but impact could be broadened in the microbiological area which would bring greater international recognition.

B 5. Additional information

This small group should look for synergies with the other horticulture programs in the department.

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Plant 11. Plant Production

Unit of Assessment: 633_2 Horticultural Product Quality and Post Harvest

B 1. General assessment of the Unit of Assessment

The unit focuses on two areas: Quality of edible plants and postharvest handling; and bioactive compounds in plants and their medicinal effects.

Within the former, quality encompasses external quality, taste and storability. The unit develops cultivation practices for achieving high quality products, and develops postharvest procedures to preserve quality. The remit of this group includes organic production with its specific requirements.

Research on bioactive compounds comprises the analysis of their anti-cancer effects in *in-vitro* studies. To run the research, the unit has developed protocols for analytical procedures for extraction, purification and chemical characterization of bioactive substances and other plant compounds of interest.]

The research profile is adequate in breadth and depth. In the first area it covers the chain from production to preservation including packaging and in the second area it includes also medicinal aspects of bioactive substances in collaboration with medicinal units of Lund University.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research in the area of quality and postharvest is mainly needs driven and is done in close cooperation with grower associations as well as the food industry. The theme “bioactive substances” has a basic research character and is innovative since medicinal investigations are also included. This interdisciplinary approach goes beyond the conventional border of plant sciences and was well regarded by the panel. The unit consistently publishes in leading journals and the publication record was considered to be significantly above for the UoAs judged by the panel. The prolific output was deemed particularly impressive as the only senior scientist of this unit, M. Olsson, contributes 50% FTE to teaching. Having this in mind, the guidance and supervision of 3 PhD theses exceeds the average of SLU. The attracted funding per senior scientist is comparable to other evaluated units.

The unit coordinates projects with national partners in science (Lund University) and industry (Findus) and is a partner in international Projects (Bioforsk Norway).

Goals and strategy of this unit are well defined and promising for the future.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The senior scientist has received several invitations to present at international and national conferences. She is also a member of the research application evaluation committee of the Research Council of Norway which underlines her international recognition. Marie Olsson is a member of the American Chemical Society and contributes to the scientific community in evaluation of manuscripts of renowned journals.

The senior scientist was awarded the Pedagogical prize of the Student's organisation in Alnarp. Her devotion to education is also reflected in the number of currently supervised PhD students which is, per senior scientist, above the level of other UoAs.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The unit has strong collaboration with stakeholders on the production side as well as in the food industry which is reflected in the amount and source of funds. The unit contributed to the "Swedish Science Festivals" and participated in other popular science presentations including a radio programme about vegetables and health. The generated knowledge is shared with society more widely and made visible for the broader public. Recognition of the expertise of the senior scientist is reflected in her membership of the previous SLU investigation group of future strategy in the research field of Food Science.

The basic science oriented work has both global impact and a long-term perspective. The panel feels that the needs driven research has more regional impact and a mid-term perspective.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The unit has a convincing strategy and the qualification to reach the set goals. The unit has good collaboration with stakeholders (farmers and the food industry) and fine international relationships. The interdisciplinary approach for investigation of the bioactive substances is promising. The composition of the group allows a flexible development since research is based mostly on PhD students bringing in new ideas and enthusiasm. The technical infrastructure was established by the UoA, but has to be further developed. In the interview with the panel, the initiative to establish central laboratory facilities to be used together with other groups was presented.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

Not applicable

B 4. Actions for development at the Unit of Assessment

Considering potential and relevance of the research done in this unit, the panel strongly suggests the establishment of a faculty sponsored professorship. This would further the scientific creativity in this unit and strengthen the profile of SLU in this area.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 11. Plant Production

Unit of Assessment: 633_3 Horticultural Production Physiology

B 1. General assessment of the Unit of Assessment

The evaluation panel considered several constraints:

- 1) The unit was composed two years ago from the remainder of three other units following restructuring.
- 2) Most members of this group have administration and other duties of up to 75 % FTE. The group also has significant teaching responsibilities.
- 3) The scientist holding the faculty sponsored professorship retired on half time (.45% FTE) and is working for the last years of his employment on Scandinavian and European networks for the faculty.

As a consequence of the genesis of this unit, research is not focused but split into three themes:
Crop nutrition and root biology (Hakan Asp, Helene Larsson Jönsson, Sisi Caspersen)
Crop physiology in woody ornamentals (Hans Lindquist, Andrea Kosiba)
Glasshouse crop physiology (Rolf Larsen)

The three subunits will be considered separately where appropriate.

The general mission of the unit is to generate new knowledge concerning sustainable horticultural production. Due to the above mentioned restrictions, the unit had not yet developed a coherent strategic plan.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

(I) Crop nutrition and root biology:

The most significant breakthrough mentioned in the self assessment is work on cadmium uptake with regard to soil and plant factors. Other research areas are mycorrhiza in horticultural field crops and P nutrition of potato. The publication activity is below average. Participation in national and international networks is not reported.

(II) Crop physiology in woody ornamentals:

The suggested breakthrough in the years 2004-2008 was related to a PhD thesis dealing with the effect of irradiation and temperature on shoot growth and development in Blue Holly. Other research fields are dormancy/hardiness and growth patterns. Only one publication was reported which is clearly insufficient. Participation in national and international networks is not mentioned.

(III) Glasshouse crop physiology:

A claimed breakthrough was the research on interaction between greenhouse grown chrysanthemum and *Frankliniella occidentalis* which was done by a PhD student. This was within the research area of dynamic prediction systems for protected cultivation which was developed in cooperation with the Univ. of California, Davis and the Univ. of Wageningen. This system analytical approach is a highly sophisticated method to analyse interrelationships in the crop-environment system. The high reputation of the international partners is testament to the quality of this more fundamental work.

Needs driven research includes studies on non-chemical methods for plant retardation and the use of LED as artificial light. Publication activity of this subunit is within the normal range for other UoA evaluated by this panel. Manuscripts were published in journals having impact in horticultural science.

R. Larsen is involved in different networks in Scandinavia and Europe.

Whole UoA:

The external funding was consistent with that for other UoA, particularly when taking into account the structure of this unit, and competing duties (see B1). The number of PhD exams was below average.

The panel had problems scoring this diverse group because of the variability in performance within it: ranking from poor to internationally recognised. The panel considered the half time position of R. Larsen when scoring.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

- (I) One member of this sub unit served in the Expert panel of Formas.
- (II) Nothing was mentioned in the self assessment
- (III) R. Larsen is representative for Sweden in the Council of the International Society for Horticultural Science (ISHS) indicating his national recognition. His international reputation is documented by two awards, one from the ISHS and the second from GCRI Trust, UK. Furthermore, he served in the scientific committee initiating and organizing the First Symposium on Horticulture in Vienna 2008.

The panel had the impression that international visibility differs quite considerably between subunits. For decision on scoring see B2.1.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

Some funding has been received from organisations financing applied research. The research of (II) on growth patterns of woody ornamentals and of (III) on growth retardation and use of LED is in collaboration with the horticultural industry. This reflects the need of the horticultural industry for significant support from science.

The research on dynamic prediction systems for protected cultivation has global dimensions with a long-term perspective. The other topics have a more regional character of medium-term impact. The group does have a role in extension activities and the production of applied literature (eg. fact sheets and guidelines), particularly for strawberry production.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA has set a goal to develop some central basic research to unite the research groups without losing the contact with the horticultural industry. The UoA suggested some potential research objectives but without strategies to achieve them. The panel has the feeling that there should be an opportunity to establish a promising and relevant area considering that glasshouse crop production will remain a significant part of the horticultural industry. The UoA urgently needs the implementation of new methodology, such as molecular biology, which could be exploited by other UoA's of this department, especially Microbial Horticulture.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

R. Larsen is already on half time and will retire in 2 years during which his research activities will decline. To invigorate this UoA, SLU would have to bring staff with new capabilities. This UoA is in need of strong leadership, a commitment to research, and the development of a research plan and focus. The panel feels that strategic funding of SLU is required to support a re-orientation of this UoA.

B 5. Additional information

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 11. Plant Production

Unit of Assessment: 634_3 Product Quality

B 1. General assessment of the Unit of Assessment

Research in this unit focuses on various aspects of crop quality, with special emphasis on wheat bread making quality, barley malting quality, nutritional quality aspects, and new uses for wheat gluten. The research profile is broad, which on the one hand is a positive aspect, but it may actually be too broad for one senior staff member to effectively supervise. During the oral presentation, it was revealed that graduate students supervised within the UoA work in three different departments. The panel questioned whether the one senior scientist might be stretching herself a bit thin. The UoA does have interactions with many cooperators in different departments, with work ranging from plant breeding to materials sciences. This breadth of activity is laudable. Not to suggest the project take on too many additional goals, but some linkages to FOMA might be considered. Climate change could impact crop quality, and this is an area in which the project could build on past experiments and design new investigations.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The project has moved from conducting work that was largely confirmatory in nature to more high risk, but higher payoff, experimental work on new applications of wheat gluten and rapeseed. The early work did reveal some new aspects of use to the wheat breeding industry, specifically the discovery of wheats expressing 6 high-molecular-weight glutenins. This was a novel discovery in a well-populated area of research. The work on new uses of gluten is novel and has potential to be economically important. There are extensive academic networks and collaborations with many different projects. The work is such that it could have world-wide impact.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The one senior member is able to provide effective leadership for her group, which, as noted above conducts diverse research. The project leader is starting to become established on the international level, with recent invitations to address international conferences and to serve as an external examiner for PhD dissertations from other nations. There is, however, no indication of service on editorial boards, or as an active member of a scientific society, and no mention of any major awards. The principal investigator has established herself as the nation's wheat quality expert, and serves as a source of information and techniques for wheat end-users, wheat breeders and producers. To become a world-wide leader, the principal investigator needs to establish herself as an expert in some unique research area. In addition, the principal investigator needs to attract or develop other scientists to move into senior positions. At present, this project contains just the principal investigator, one post-doctoral research associate and some graduate students. The principal investigator also is spending 50% of her time as a Vice-dean. It is unlikely this UoA can develop more of a world-wide reputation without the addition of another senior scientist. The panel considered that the principal investigator would be capable of doing so, if more of her energies could be focused on research. However, the additional administrative and teaching duties could very well inhibit further development of this project. Finally, while there is some indication, via the self-assessment and the oral presentation, of significant new developments in the field, the published work to date is, for the most part, of an incremental nature. Publications report sound experimentation of international standard.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Training of graduate students in techniques of wheat protein evaluation will contribute to their ability to improve wheat varieties in their home nations. There is some potential for contribution to societal and industrial sustainability. If the work described on new uses of gluten and rapeseed flour should successfully make the transition to commercial production, there could be significant economic impact on industry, and an increased demand for the produce of Swedish farmers. However, it should be noted that, unless the new applications are both truly novel, and cost effective, successful technology transfer is unlikely. At present, there is potential for outstanding contribution, but that potential has perhaps not had the time to be realized. The recent forays into new areas (for this project) such as nutritional quality of sea buckthorn and apples, are positive signs and have potential to benefit society.

Most work conducted in this project has had regional/national impact only. Again, there is potential for global impact, but such impact shall come only with successful technology transfer and industrial adoption of the new uses of gluten.

On the basis of this evaluation, award a score from 1-6 ³:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The future research potential of this UoA is high, but potential might not be realized should the principal investigator not be able to contribute more time to research. The UoA would clearly benefit from the addition of more scientists. A positive aspect seems to be that the principal investigator has established a number of ties to additional academic programs and to industry. It seems significant that only one of the goals listed in the self-assessment's strategic plan, namely "to develop some products for the industry that can be patented and developed into industry products" is actually a research objective. The remaining goals are administrative and directed to obtaining more funds to hire more people to conduct the work.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

This group needs to develop and/or recruit additional permanent scientists. The sole senior scientist is considered to be stretched too thinly to provide effective day-to-day scientific leadership. The group also needs to carve a unique niche for itself in the field of crop quality. Once this is achieved, the international recognition and invitations should follow. The group also needs to anticipate whether changing demographics of Sweden might present new opportunities for crop quality investigations. A more diverse diet, and more diverse eating establishments, might create demand for food products not formerly produced in Sweden.

B 5. Additional information

The primary investigator of this project is serving as Vice-Dean, and this occupies a significant portion of her time.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 12. Soil and Aquatic Sciences

We identified several key issues:

- Many research areas are clearly relevant and have considerable impact relative to stakeholder needs. The high level of applied research in an institution that also supports very basic research is a key feature of SLU.
- A poor career pathway coupled with a lack of tenure and secure funding for faculty salaries restricts innovation and hinders recruitment and retention of excellent faculty.
- There is an obvious gender imbalance at senior levels. We could not elucidate causes for this serious imbalance, but we hypothesize that it is due to the funding instability for faculty.
- There is clear fragmentation within the Soil and Environment Department. There is overlap of research area among different units and a lack of collaboration among similar units or among groups that could quite logically and productively collaborate. We wonder if a thematic reorganization might be useful. For example, a number of scientists all study metals – or greenhouse gases – but they are all in different units. Faculty need more flexibility of structure, and effort is needed to remove barriers so that new groups can be formed to go after novel questions and topics. Clearly the Umea group has figured this out – perhaps it is the mindset of other faculty that needs to be changed.
- Although there are many exceptions, too many faculty lack an international. We recommend finding ways to send students and postdocs abroad, give mid-career sabbaticals.
- There is a lack of high-impact, tier-1 scientific publications – particularly in the agricultural sciences. They need higher aspirations for publishing and need to move beyond conference proceedings and reports.
- There is a widespread tendency for FOMA activities to dominate research. SLU is unique in that FOMA activities and monitoring are brought into the research context; while this is excellent, but there are also potential tensions. Many units have stated that FOMA activities are very time consuming and thus time for basic research and publication in highly ranked journals is limited. This will only change if the funding structure of salaries for researchers is changed so that a larger proportion of the salary is fully covered by SLU.
- Some units are carrying out basic research on the basis of FOMA activities and funds. This can be good in many cases and when the funding agency is in agreement.
- The coordination of FOMA activities seems unclear. Certain activities such as data management and public outreach could benefit from better centralization.
- Many units have separate international activities. There is a need for coordination of international activities if this is to become a growth area at SLU.

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 241_3 Soil and Plant-Soil Interactions

B 1. General assessment of the Unit of Assessment

Our panel felt that this was the strongest group that we met, and indeed, their research is considered absolutely top tier international science. This group's research on soil-plant interactions is experimental in nature and includes collaborators from a broad range of disciplines and from many countries. Like many units, they have a hydrology/biogeochemical research/monitoring component to their research, and they have an excellent mix of observational or monitoring level information and detailed studies of ecological, microbial and chemical processes. The research is inquiry and hypothesis driven, and is generally published in top tier journals. Much of the research is fundamental ecosystem function research, most notably the work of Högberg with tree girdling and ¹³C labeling of trees. This research is extraordinarily well cited and regarded by the international community, and is the related work on fundamental processes in N cycling by more junior members of the group. They are involved in biodiversity experiments that are pan European, their trace gas work has global implications, and they are involved in the writing of theory papers that are truly paradigm pushing. The research of all senior faculty in this unit – from Hg dynamics to catchment science – is exciting, hypothesis-driven, and published in excellent journals. The metals work is a model for how to push the envelope in basic science while having strong implications for very applied environmental monitoring and assessment. They are the only group that truly saw teaching as a bonus and not a burden, they found innovative ways to merge very applied and basic research, they gave an extremely polished presentation, and we wondered what their secret was at SLU to be so extraordinarily productive compared to many other groups that we saw.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Methods, hypotheses, productivity, and impact are excellent. We do not need to extensively comment on methods, productivity, impact or prominence because they are all excellent. Our only recommendation was to continue to collaborate internationally and try to build their group in Umea.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

The senior faculty are all well respected leaders in their fields – most of which address very basic science issues rather than extremely applied issues. The group as a whole provides an extremely attractive research environment; Högberg in particular has an outstanding reputation at being able to build research teams that are truly interdisciplinary.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Their research contributes to the scientific base of four of the environmental goals of Sweden: Reduced climate impact; Natural acidification only; Non-toxic environment; Sustainable Forests. There are obvious links between their research results and priorities and stakeholder needs for new knowledge concerning important challenges for future sustainable energy production through intensified forest growth, including studies addressing forests and peatlands as sources and sinks of carbon. The need for more renewable energy sources and mitigation measures against climate change puts forestry and other land use high on the agenda worldwide.

Also the effect of forestry on quality of run-off water has clear applications. The group demonstrated a mature and holistic view on the interactions between teaching, monitoring and research, and look upon students as a resource and as future stakeholders within the forestry sector.

They have very good networks connecting to both authorities, forest industry & sector organizations.

The excellent research results from this unit will be of high relevance and also have considerable impact and cover societal knowledge needs in these areas, but due to the basic research nature of the research it may take some time before the most basic research results can be applied.

Regional/national /Nordic scale
Medium and long-term impact

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

They have a clear plan for the recruitment and mentoring of junior faculty. They are the only group that appeared to be concerned about the gender balance in their unit. They are very highly collaborative both within SLU and with similar international leaders.

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

There was very little direct FOMA activity, as this group has a strong focus on basic research. That being said, the applied implications from their work are extremely clear. The metals work is an outstanding example of how detailed basic science is needed to gain a mechanistic and predictive understanding of toxin behavior in the environment. The fundamental forest ecosystem research addresses global change issues, albeit somewhat indirectly.

B 4. Actions for development at the Unit of Assessment

We wish we could offer more advice – but if there is advice to be offered, this group needs to be left to do what it does best, given additional resources, and possibly allow for more secure funding that would promote recruitment of additional faculty. This group is a jewel in the SLU crown, and should be strengthened.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 280_1 Aquatic Geochemistry and Environmental Chemistry

B 1. General assessment of the Unit of Assessment

This UoA is well recognized internationally for water-quality monitoring and assessment. The group ranks at or slightly above the median in most of the bibliometric indices, but the panel notes that many of the publications are in high-impact international journals. This UoA has led development of monitoring approaches within the EU and has published important papers on catchment hydrochemistry that have had international impact. Kevin Bishop, the leader, is well known in his field throughout the world and recognized as a leading figure in dissolved organic carbon transport and its interactions with other elements. The work on pesticides is potentially worth pursuing, but requires the appointment of a faculty professor before it can be well integrated into the UoA.

The group has a broad interest in many contaminants. This interest follows their orientation towards societally relevant questions, but has the danger of not developing sufficient depth in any one area. There is a very tight integration between FOMA and research. This has resulted in many important publications, but there are a large number of papers exploring correlation of factors and a smaller number of process-oriented publications. The self-assessment did not make clear the interplay of research and FOMA activities, but the oral presentation contained a compelling vision with a healthy synergy between FOMA and research. Nonetheless, the dependence on FOMA funding can result in monitoring dictating the research agenda unless care is taken to keep a broader perspective on the most fruitful (as well as the most relevant) lines of research. The panel also expressed concern at the recent increase in FOMA funding, which, coupled with level research funding, makes the UoA vulnerable to any future decreases in demand for chemical monitoring. A more even funding portfolio between research and FOMA would be a more stable strategy.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This UoA has an international reputation for both basic and applied research. The group has played a leading role within Europe on development of reference standards and critical loads. Internationally, this group is recognized as experts on catchment biogeochemistry, particularly with regards to dissolved organic carbon. This UoA has produced critical papers that have had global impact on considerations of the role of the riparian zone in influencing surface water chemistry. Its particular niche has been the larger scale analyses identifying key patterns that require further explanation. The group principals have been highly productive; given the size of the group, the productivity per researcher is average. There is some confusion over the bibliometric analyses, but the overall impression is that there are highly

productive leaders with much lower productivity among the rest of the group. This group excels at collaborations within SLU and around the world; they see no barriers to cooperation. There has been some work on designing monitoring networks in developing countries which employs a capacity-building approach that is commendable. Of particular note is the planned collaboration with Nick Jarvis thus bridging between a forestry and agricultural group.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

This UoA is a leader globally in research on recovery from acidification, mitigation strategies, dissolved organic carbon in natural waters, and catchment hydrochemistry. Its leaders are active at the European and national level on policy issues concerning recovery from acidification and mitigation strategies for forests. They have done an outstanding job in getting information out to the public and other researchers in their pioneering work of moving monitoring data to the web. The extension of work from acidification and metals to pesticides is notable and consistent with their overall strategy of addressing issues of concern to society.

Internationally, this UoA actively participates and organizes conferences and symposia. The panel noted that this UoA provides some base funding for all researchers, an important strategic measure that we strongly support. There is also a clearly stated strategy for career advancement to *docent* level. Such structural changes are critical for the sustained success of this group and others at SLU.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Clearly relevant concerning acidification and long-range transport of nitrogen and hazardous substances (Hg and POPs). Also relevant concerning impacts of climate change on interactions with long-range transported pollutants and the chemical composition of surface waters. Ensuring relevance to biological assessment is essential to maintain the impact of this work in the future. There is a risk that the funding for acidification and water chemistry monitoring will decrease in the coming years due to decreasing acidification and also the water framework directive (WFD) invoking a legal need to focus on biological components of aquatic ecosystems and also to focus more on continuous eutrophication problems and less on diminishing acidification problems. If the unit tries to focus more on small headwater streams, this may also be difficult due to the WFD focus on larger water bodies. The ambitions of the unit should be adjusted to the appropriate level in order to meet these needs.

Research and impacts span the scale from global to regional, and they take a long-term perspective

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

For all of the notable research accomplishments, the panel has the greatest concern over the strategy of the group, both from a scientific and sustainability point of view. The dominance of FOMA funding (if the figures provided to the panel are correct, for many errors have been noted in these data), indicate that research funding for research has been fairly level, but FOMA funding has doubled (15 to 31 MSEK) over the past three years. The strategy and the five most important papers described in the self assessment showed a focus on pattern recognition rather than process understanding. The desire to further broaden the group to cover other contaminants heightens that concern. This is a weakness that this noted in the self assessment, but not well addressed. There is concern that the research strategy is captured by the monitoring rather than using the monitoring and assessment to help advance a research agenda. Furthermore, the UoA's dependence on FOMA funding makes the group vulnerable to any shifts in monitoring priorities by funding agencies, which can occur with little notice. The panel recommends greater balance in funding between research and FOMA as a more robust model for the sustainability of the group.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

This UoA has responsibility for a national-scale chemical monitoring of lakes and streams. This is a large-scale operation that requires professional management. The lab has the appropriate accreditation. There have been modifications made to the monitoring program as a result of the assessment work; this feedback is healthy and indicates the proper scientific management of a monitoring activity. The group is recognized as a leader in Europe and internationally on design of monitoring networks. The work is relevant to current issues, but remains heavily tied to acidification. As new issues emerge, the group will have to adapt. Such adaptation may require substantial changes in analytical instrumentation, field methods, and training. Little consideration of potential changes was evident in the self assessment.

B 4. Actions for development at the Unit of Assessment

This UoA needs to consider potential changes in regulatory requirements which could threaten their current monitoring network. For example, regulations could decrease emphasis on chemical monitoring and increase emphasis on biological monitoring. Although recognized by the UoA in their development of the "aqua incognita" effort, there is the continuing need to demonstrate to the funding agencies the importance of combined biological and chemical monitoring through effective assessments, which combine both aspects.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

The integration of FOMA and research requires careful handling. Notwithstanding the success of this UoA, there remains the need to ensure that excellent scientific research sets the agenda for a university research group.

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 280_2 Aquatic Ecology and Biodiversity

B 1. General assessment of the Unit of Assessment

Research at the UoA has been mainly of an applied nature, addressing the development of concepts, approaches and methods relating to biological assessment, particularly in the context of the EU Water Framework Directive. The group has been successful at publishing this work in international specialist journals, although there has been a traditional focus on specialist aquatic journals. Following a recommendation from a previous evaluation, it is pleasing to see that more effort is now being made to publish in journals with wider readership and higher impact. The group and their work are well known and respected within Europe, but perhaps less than they might be globally, and improving publication performance will help address this.

In contrast, the UoA has carried out and published rather little fundamental process-oriented research, although they have aspirations to do more of this kind of research which could raise their international impact and repute. To this end they have adopted a strategy of recruiting promising young researchers and allocating them time for research. This strategy will take some time to bear significant fruit, but should be strongly encouraged.

Overall the UoA demonstrated good synergy between FOMA and research. The FOMA has provided a platform for substantial research income, mainly from the EU, which has underpinned much of their publication output. They are now more actively seeking ways to extend this synergy to pose fundamental research questions, and there are good prospects for success.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The UoA identified its central research issues to be '*developing indicators that respond to stressors*' and '*understanding the ecological processes affected by these stressors*'. In practice, research by this UoA appears to have been largely focused on the former issue with relatively little work on the latter. This is understandable given its commitment to FOMA and the recent pressure to develop agreed concepts and methodologies for implementation of the EU Water Framework Directive. The publication record of the UoA reflects this, with an emphasis on the concept, development and validation of indicators. The work of the UoA in this field has been impressive, and staff have been key players in many European networks/projects aimed at coordinating and standardizing national approaches. Because of the emphasis on the EU directive, the academic networks and collaborations appear to have been primarily European. However, even if other regions adopt different specific procedures, the principles and concepts underlying assessment and monitoring are global, and the UoA would benefit from developing wider international collaborations and raising its global profile. Some research effort has also been directed to influences of climate on aquatic systems and to the environmental fate and impacts of organic pollutants, but these have a

rather lower profile.

The bibliometric analyses point to a productive and successful UoA but one with, to date, a strong emphasis on needs-driven research. The various indices are mostly around the average for the field. Output in peer-reviewed international journals is solid, but to date has been overwhelmingly in specialist journals. The UoA has identified a goal to broaden the range of journals they publish in, and they are showing early signs of success with this goal; certainly the capacity to produce research findings publishable in more general journals with a broader appeal and readership is both a sign of originality and impact, and is also a route to greater international prominence. The panel also noted that all listed major grants were from the EU; achievement of more original research with wider potential impact will almost certainly require an ability to win grants from research councils etc which do not impose narrowly defined goals for the funding.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The research environment appears attractive and well equipped. The accredited biological and chemical laboratories that underpin the FOMA work are a major asset. There is a clear impression of a UoA that operates as a coherent unit with a strong 'team spirit' in which young researchers and PhD students are motivated and supported by a combination of explicit and implicit mentoring. The UoA appears to have thought carefully about its recruitment and retention strategy and has been able to make some key appointments in recent years in an attempt to foster its research, although this process must be sustained. It also appears that the UoA has developed a strategy to allocate funds to enable staff to pursue research. This is commendable, and should probably be targeted especially at younger researchers who might be expected to be less able to secure independent research funding. The UoA has some commitment to training, at PhD and Masters level, but this might be expanded. It was disappointing that of the 10 PhD/Lic degrees awarded during 1998-2008, the careers of only 2 students were reported. SLU's strategy rightly states that '*students will continue to be sought after in the labour market*' Monitoring students' careers following graduation is essential to ensure that this is the case and that training programmes at all levels are appropriate,

There is no doubt that this UoA is able to lead the debate in its own specialist field of assessment of aquatic ecosystem health. In contrast, there is little evidence that the UoA is leading the debate in wider aspects of aquatic science. From the various reported data that can be used as 'indicators of esteem', it appears that only Johnson has any really significant international recognition profile in the wider scientific community. On the other hand, the UoA clearly fulfils a role as a trusted and much sought after source of expertise and opinion by government agencies and other stakeholders. The independence of the advice and opinions from the UoA should not be doubted, but in view of the close connections between the research and FOMA activity, and the close relation to and dependence (for funding) on SEPA, it will be vital for the UoA to be seen to maintain its independence and integrity.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

Given the basic rationale and mission of the UoA, there is no question but that its relevance and impact are currently of very high importance and that they will remain so in the future.

The UoA has an important and valued responsibility for biological assessment of conditions in Swedish surface waters. The UoA has a good reputation both nationally and internationally. There are wide contacts with stakeholders and outreach activities. The UoA recognizes the mutual benefits when interacting with stakeholders; provision of insights into societal needs and knowledge of research methods and results respectively.

However, the present situation should not be taken for granted. The self-Assessment gave an impression of willingness from the UoA to increase and improve interactions with stakeholders and also a wish to find new stakeholder groups. The self-assessment also highlighted an intention to influence managers and policy-makers to a greater extent and also to improve communication with end-users. However, these intentions and plans were not clearly formulated during the oral presentations and interviews. The panel recommends that the UoA performs a stronger analysis of stakeholders and their needs, and develops a clear communication plan including best measures and channels to use. This should be done in the interest of fulfilling the UoA mission.

The UoA rightly identified itself as good with the EU Water Framework Directive, and this has been a key source of funding. However, as this progressively moves from the development phase to full implementation it is possible (probable) that opportunities for funding and associated research will diminish. The UoA needs to prepare for this and ensure it is able to establish replacement funding streams.

At present the relevance and impact are regional/national and Nordic/European and primarily of medium-term dimensions. The UoA has the expertise and basic infrastructure to provide an expectation that it could develop these to global and longer-term dimensions.

On the basis of this evaluation, award a score from 1-6 ³: 5

4. Strategy and Potential

The future research potential of this UoA is high. The panel strongly endorses the stated goals of increasing involvement in basic research (and strengthening linkages between basic and applied research) and of increasing the experimental focus of the research of the UoA. The ongoing strategy of recruiting young aquatic ecologists of outstanding promise for innovative research is sound, although it is unclear where the resources will come from to continue this in the future. It will also be essential to ensure that the promise of these outstanding new recruits is not quickly extinguished by a requirement to undertake too much needs-driven research or FOMA to balance the UoA budget. The UoA should also pay attention to the gender imbalance at senior level.

Otherwise the stated strategy needs focusing and firming; at present it is mainly a list of very worthy intentions with no clear indications of HOW these intentions will be tackled and with what probability of success.

One of the keys to future success will be to exploit better the enormous potential synergies between the FOMA monitoring data and the research expertise of the UoA. The panel was surprised that the UoA strategy did not explicitly include plans to use the data for ***predictive modelling*** of future ecological responses to environmental change. This might be an excellent

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

approach to expand work on the second central research issue of the UoA on understanding ecological processes. As well as providing predictions of value to stakeholders, such modelling could help identify key future research questions, identify where research of a more experimental focus would be valuable, and help to frame well-rationalised fundamental research proposals to research councils etc. Although some forms of modelling are currently undertaken within the UoA, appointment of an ecological process modeller should be considered in future recruitment discussions. Alternatively, the necessary expertise might be sought through collaboration.

The score awarded below reflects the panel's perception of a high *potential* but a weaker specific *strategy* that still needs fleshing out.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

The UoA has substantial FOMA operations which it executes to a very high standard.

- i) Quality is excellent.
- ii) The UoA Foma operations are internationally recognized and esteemed, particularly within Europe where UoA staff have played key roles in developing and maintaining standardizes and cross-calibrated procedures, particularly in relation to the requirements of the EU Water Framework Directive.
- iii) Very high indeed.
- iv) Strategy and potential as stated in the self assessment can be considered very good. However, the panel missed any explicit aim from the FOMA operations perspective to engage more with related research activities.

The UoA identified a risk of consultancy firms taking over monitoring work and concluded that more communication is needed with stakeholders stressing the added value of the UoA regarding assessments and research. The panel agrees that changes may occur in the future and that the best preparation is well-informed (educated) funders and stakeholders.

B 4. Actions for development at the Unit of Assessment

The current strategy of improving publication performance and recruiting promising young researchers should be supported.

International links are currently strong, but mainly within a European context, Wider international links should be actively pursued. The UoA could encourage PhD students and postdocs to spend time working at overseas research groups, as well as pursuing mechanisms for encouraging more overseas visitors.

More effort could be made with outreach activities related to FOMA

B 5. Additional information

The self assessment did not indicate any connections with the terrestrial biodiversity unit, although there should be issues of mutual relevance.

Many aspects of FOMA, such as data base management and publicity issues, currently appear to be handled by individual FOMA units. There could be considerable efficiency and effectiveness benefits from organising these at institute level.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 12, Soil and Aquatic Sciences

Unit of Assessment: 435_1 Soil Carbon and Greenhouse Gases

B 1. General assessment of the Unit of Assessment

The overall mission of this UoA is to advance the knowledge of processes regulating greenhouse gas emissions from soils, and it appears that this unit has chosen to focus on forested soils. Included in this analysis are effects of forest management and land use change on GHG emissions as well as potential effects of climate change. They take full advantage of the Swedish Forest Soil Inventory (NFSI) which is a key resource available to the group. They have excellent research infrastructure with CARBO-Extreme (a large collaborative EU project) and their soil warming experiment, and results from these studies will certainly bring international attention. Results from their well-funded LUSTRA work resulted in a special issue in Biogeochemistry and are gaining attention. The group, while quite newly reorganized, appears to work well together and they have excellent collaborations outside their unit in Sune Linder, Goren Agren, and scientists at METLA, among many others. At least one recent PhD from this group who is still a young researcher with the group has expanded the scope of research here to DOC leaching from soils and is a rising star. The 5 major papers that they cite truly are major papers in excellent journals. This being said, the review panel was surprised by the exclusive focus on GHG emissions from forested soils, with little attention given to agricultural soils (which is a shortcoming at SLU). We found it surprising that there was little interest in using their tools to examine controls on GHG in arable soils, and that the one position that was being sought was for a peatland soil scientist. The group also has a strong modeling focus, although the models are all developed elsewhere and are run here at SLU. The relevance of the research to the international scientific community is clear, and they have a strong Foma orientation. They lead a climate change Foma, although they have trouble hiring staff for this work due to formal employment rules at SLU. They self-identified that their publication rate is too low, given their involvement in a number of well-funded projects; we agree with this assessment.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Curiously, the really novel and hypothesis-driven research in this group is not the greenhouse gas work, but rather the DOC research led by Professor Berggren Kleja, and by Mats Fröberg, a young scientist with a PhD from this group. Although this seems unrelated to GHG, it is highly relevant to the soil C mission of the group. This work in particular has a network of collaborators that is truly international and that reads like a who's who of forest ecosystem science. This work, while done in Sweden, has implications for forest biogeochemistry across the globe. The carbon stock work is less hypothesis driven and less truly innovative, but is really important for C assessment analysis. More data mining of the NFSI data could and should be done. The use of models for these analyses is excellent although not totally

innovative or envelope-pushing. It would be wonderful if there were true collaborations with GHG and soil carbon work in agricultural soils, using similar methods and models – this would be truly novel! The research in Ethiopia is also commended, although again, it is solid but not scientifically novel. There appear to be many groups at SLU who conduct agriculture-related research in Africa, but there seems to be almost no collaboration or coordination.

On the basis of this evaluation, award a score from 1-6 ¹:

4

2. Recognition and Leadership

Because so much of the research conducted by this UoA is very stakeholder driven (even when the stakeholder is the UN, or climate change modelers), the GHG research is useful to the UN, but is very applied and budgetary nature makes it less relevant to process-level research that is the centre of much international work. Thus the GHG researchers seem less connected to the international community. That being said, there are quite a number of papers where scientists from this UoA are co-authors with many extremely well known scientists outside Sweden, and these are papers in top tier journals and are extremely well cited papers. A review paper, for example, with many people from this UoA is well cited and really moved the field forward. Many of the DOC papers have an amazing cast of authors from outside Sweden, and in this case, these scientists are definitely seen as true leaders in the field.

On the basis of this evaluation, award a score from 1-6 ²:

4

3. Relevance and Impact

Highly relevant work with high impacts on society relative to greenhouse gas emissions, mainly for forest soils. This work is clearly needed by public authorities to develop policies and to participate in international negotiations. The unit has major contracts with the EPA for this work. The unit has understood the growing need for environmental assessment to serve decision makers with comprehensive analyses. They have extensive contacts and interactions with stakeholders and the unit shows an understanding for the growing interest from the general public. The unit sees a growing interest for the research, as well as Foma activities and assumes these to be continuous in the near future. This is also the case for financing possibilities. We agree with this picture. The research is highly relevant for the decision support that is needed and will be needed.

The focus mainly seems to be on carbon and less on nitrous oxides. This may be one of the few weak points.

The main focus of this UoA is quite regional and national in focus by design, and this is highly appropriate. The implications of the research are, however, global. Much of the CO₂ work has implications for forests throughout the world, and similarly, the implications of the trace gas emission work could be applied to soils across the globe.

On the basis of this evaluation, award a score from 1-6 ³:

5

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

We think the two main areas of realisable high potential within the UoA strategic plan are the work on leachable DOC and the continuation of model development integrated with experimental work, modelling and data base access. The former activity is dependent on keeping Fröberg in the group, the second is dependent on continuation and development of the integration between FOMA driven monitoring work, experiments and continued access to databases held by other UoA's within the department. We feel that the UoA would be better off developing links with existing UoA's working on peatlands (Soil and Plant-Soil Interactions) rather than obtaining a dedicated professor in peatland soils.

In the presentation future perspectives / directions regarding delivering reporting for Kyoto and post-Kyoto scenarios are of course important but the UoA should focus on more processed based work that will allow them to interact with the post Kyoto funding environment rather than aiming to modify their activities to provide service work.

We note that the UoA is relatively small and therefore vulnerable to losses of junior staff. It is good to see that two junior research fellows and one postdoc have recently been recruited and two PhD students are currently being recruited. We note that the UoA has a budget to support individuals where finance is not sufficient and we commend this. We also note that the UoA is involved in two graduate programs to support postgrads. To further promote the development and retention of younger faculty we would like to see the UoA moving to a position of being able to support younger staff in the same way as UoA's from the Aquatic Science and Assessment Department and the Plant and Soil-Plant Interactions UoA, with 50% (1:1 research and FOMA) funding provided. Only by providing more guaranteed salary will any UoA at SLU become a destination of choice for talented academics.

The gender balance within the group is not as bad as in some UoA's but still requires work. There is a male:female ratio of 2:1 with women comprising junior staff and men comprising male staff. Recruitment should be based on excellence and not gender but there are excellent women out there.

There are many opportunities to exploit synergies between UoA's that are currently unrealised. Typical of these (and typical of the general lack of interaction we have seen between most UoA's) is the strategic aim of recruiting a full-time professor in "peatland soils". A better strategy would be to strengthen links with the Soil and Plant-Soil interactions UoA which currently has a full-time professor in peatland soils who is doing excellent work. Similarly there is some interaction between Gustafsson (Biogeochemistry UoA) and this UoA but we believe that this interaction could be greater. The UoA should potentially increase interaction with those UoA's working on agricultural systems and provide methane and nitrous oxide expertise so as to be able to present a full land use perspective rather than just focusing on forest soils.

On the basis of this evaluation, award a score from 1-6 ⁴:

3

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

See comments under relevance and impact

B 4. Actions for development at the Unit of Assessment

Develop links with the Plant and Plant-soil Interactions UoA to realise potential of work on peatland systems.

Transfer Gustafsson from the Biogeochemistry UoA to this UoA to strengthen work on metal - organic carbon binding.

Fast track Fröberg to Professorial status in order to keep your rising star and maintain and develop work on DOC leaching.

Provide 50 % funding for younger members of the UoA so that they do not have to chase salary all the time.

Strengthen process driven research as informed by monitoring data.

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 435_3 Plant Nutrition and Soil Biology

B 1. General assessment of the Unit of Assessment

The UoA integrates the research disciplines of agronomy, plant nutrition and soil biology in both cool temperate and tropical agricultural systems. The UoA's research profile and activities have centered on the development of a basic understanding of both the abiotic and biological controls on carbon (and to a lesser extent, nitrogen and phosphorus) cycling in arable soils. The UoA has a long history in the development of internationally recognized soil carbon cycling and balance models (including maintenance and utilization of Swedish long-term trials) and more recently, the assessment of the environmental impact of organic agriculture as a food production system. There is an increasing multi-disciplinary focus on tropical agriculture within the UoA, including research into resistant black carbon as an aid to productivity and the recycling of inorganic nutrients from organic sources, specifically P, which is consistent with regional research priorities. The group's long-standing expertise in organic carbon and nitrogen cycling has provided the necessary platform for investigating the interactions and synergies between organic and conventional forms of agriculture and its role in sustaining in temperate and tropical environments agriculture. Links to FOMA seem tenuous and not clear or necessary, however the recent development of a new program in soil biology monitoring does provide close links with the group's more basic research efforts of the past.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This is a relatively small, top heavy UoA which has concentrated on basic research outcomes in the past, with long standing internationally recognized leadership in soil biology, carbon cycling and nutrient recycling. Recent "visionary" comments on research methods, rigor, originality and related shortcomings in soil biology are outdated and do not offer new solutions to widely known inadequacies; the paper states the obvious. This exemplifies the increasing narrow mindedness of leadership and overall vision in this UoA. The recently published work by Kirchmann et al. in organic agriculture, whilst providing concrete (and necessary) evidence on some of the failures of organic agriculture, needs to be interpreted within the narrow geographical environment in which it was developed. We consider the quality of the research to be (historically) high and internationally relevant and prominent, however effective visionary thinking and impacts also requires some degree of open-mindedness, adaptation and humility, which is lacking in this UoA. The UoA came across as arrogant and unduly adversarial which is counter-productive. The declining external research funding base is indicative of a group now lacking productivity, impact and quality in both basic and applied activities, with the possible exception of P extraction from organics. The increased contact with TSBF and developing world agriculture (and their scientists) is

noteworthy and provides an ideal environment for this group to re-engage the international community and provide innovative solutions to sustainable food production in tropical environments. Increased internal financial support to junior researchers (e.g. Roing), which we have been told (repeatedly by many UoA's) is plentiful at SLU, would provide a catalyst for innovative research and potentially re-establish the prominence of this UoA.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

Professors Andrén, Kirchmann and Kätterer have all demonstrated high level research skills in the past and continue to make contributions to the international community. Kirchmann's expertise in nutrient cycling in both organic and conventional agriculture provides significant leadership and prominence in this internationally significant debate. A downside is Kätterer's administrative load (and lack of core funding), which removes a strong pillar in mathematical analysis. The new emphasis on black carbon research and impacts on soil fertility, microbial activity and productivity (mainly in an African setting) is noteworthy and is an emerging area in international agriculture which requires the rigorous evaluation that this UoA can provide if sufficiently motivated. The development of a strong, respected research groups with a suitable critical mass for growth and innovation and interdisciplinary research (which has been a hallmark of SLU's success in the past) may be hindered by the intellectual and philosophical domination and attitude of one or two senior researchers in this UoA. It is not completely clear whether the small size of the UoA is due to the presence of strong personalities, non-inclusivity (which has not been a problem in the past) or lack of vision or motivation in the development of new opportunities in the region. Fragmentation at the Department level may also be contributing to the inability of this UoA to develop a harmonious critical mass. The UoA's broader role in society is difficult to assess, however the soil C balance research has played a major role in examining Sweden's arable greenhouse gas liability and the work in organic agriculture and soil fertility has definite applied impacts.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Most of the work is highly relevant for society/agriculture/industry: questioning the potential for organic farming versus conventional farming relative to nutrient leaching, extensive land use, low efficiency of food production etc., as well as P-recycling from waste to new fertilizers, attempting to establish a new industrial technology for this purpose. They are also reporting to EPA on the agricultural contribution to greenhouse gases, through a national inventory. The self-assessment and part of the presentation gave the impression of "Besserwisser" attitude, as well as "we are badly treated". A clearly hostile attitude was revealed concerning stakeholder needs, expressed by saying "there has been too much disturbance from stakeholders, we have our own agenda". Unwillingness to communicate their results in a balanced way taking also other conflicting results into account will most likely reduce the potential impact of their research efforts. They consider themselves as having a mission to enlighten the world on controversial subjects and correct misconceptions

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

concerning organic farming. If this is taken too far their research may undermine any potentially positive impacts of organic farming on the environment. This is why we propose a score of 3 and not higher.

Also considerable work on sustainable agriculture has been done in Africa, funded by SIDA. This work seemed more balanced in terms of ability to differentiate areas where organic farming would be beneficial relative to other areas where conventional farming would be preferable due to the need for efficient crop production on limited areas. Also relevant work on enhancement of yields and improvement of crops quality and soil fertility that can have good impact on the development of agriculture in Africa. This work therefore deserves a higher score (4 or 5).

A striking feature is that out of 16 PhD exams there are 13 women, but this is not reflected in the current staff of researchers, suggesting that the large majority of these PhD-students were not offered any continuation of their careers within this unit. No info is provided in the self-assessment nor in the presentation on the future career of these former PhD students.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The UoA have based their future on continued investment in current activities which potentially lack the innovation required to increase their rapidly declining external funding base. The P extraction from organics work is new and patentable but not detailed in anyway for the panel to evaluate its potential for success. Black carbon and soil fertility research in Africa is a significant opportunity, but again, no information has been provided to assess its full potential for continued support and recognition. Curiosity driven research has been the historical norm in the UoA and has received deserved recognition, however relying on past efforts and the (now) seemingly plentiful internal funds has produced a complacent and unproductive research environment which is lacking the necessary vision. Past synergies and collaborations across SLU need to be re-ignited and the personnel within this UoA could potentially be amalgamated with the Biogeophysics and Water Quality UoA. Younger female faculty (i.e. Röing) have displayed a keen sense of enthusiasm and curiosity aligned with the UoA's current activities warranting significant support and mentoring.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

This is an undeveloped activity in this UoA and the information supplied in their self-assessment is not sufficiently detailed for an evaluation. The lack of development of FOMA in this UoA is understandable considering the interpretation of soil biological indicators is entirely questionable and in many cases open-ended.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 4. Actions for development at the Unit of Assessment

The UoA lacks significant vision and strategic direction at the senior researcher level which reflects poorly on their international standing and prominence. This may be in response to higher order management problems at SLU (as reflected in the overall discord displayed in the UoA Self-Assessment document). Their current research in black carbon, nutrient cycling and organic agriculture has both regional and international merit, however the (lack of) strategy and overall attitude presented to the panel does not instil confidence in these research efforts being anything more than short-term, transient areas of discovery. To retain its current independence, the UoA requires a re-assessment of their future research efforts and goals, including re-opening relationships with other groups within SLU and renewed links to regional stakeholders to ensure their longevity.

B 5. Additional information

The panel considered it most unfortunate that this UoA failed to engage properly with the evaluation exercise, neither in the self-assessment document (which lacked serious self criticism and was frivolous), nor in their meeting with the panel. They should understand that both self examination and external peer evaluation should be viewed as constructive elements of developing good science and scientists.

There also appears to be a serious failure within SLU senior management and the Department of Soil and Environment to promote interdisciplinary research, including no clear articulation of the roles and scope of both basic discovery and applied research and the strategic direction at Faculty/Department levels and SLU collectively. The overlap of research expertise between UoA's in this department and lack of collaboration and interaction seriously undermines the ability of SLU to provide comprehensive, systems based assessments and publish internationally significant, process based research.

Part B: Report on individual Unit of Assessment

Panel 12. Soil and aquatic sciences

Unit of Assessment: 435_4 Biogeochemistry

B 1. General assessment of the Unit of Assessment

We recognize that this is an extremely new UoA and thus the UoA has not realized its full potential. The UoA carries out research within the broad field of biogeochemistry and identifies 3 areas of core competency - soil-plant interactions, metal binding mechanisms in soil and radio-ecology - in addition to monitoring work. This represents a wide range of interests. Within these fields, activities in soil-plant interactions were hard to determine from the presentation but the documents indicate activities in assessing problems with organic farming and fruit crop growth. Metal binding work is focused on sorption experiments and spectroscopic techniques to derive modeling parameters for metal mobility and speciation. Radioecology is concerned with issues relating to Chernobyl and state of preparedness for any future nuclear accidents. The metals work came across as solid work, the rest failed to impress. There was little indication of any synergies between research and environmental monitoring - one PhD concerned with metals work had used archived soils from monitoring activities with little indication of multi- or interdisciplinary activities.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The metal speciation and synchrotron spectroscopy work is internationally recognized. Choice of methodologies for this work is on the whole good and the work addresses questions of international relevance. This work is published in high impact journals for the field. However, the group is using techniques which are already widely used and must take care not to be left behind as increasing numbers of microfocus beamlines are commissioned at synchrotron facilities around the world.

The documents and presentation failed to demonstrate that the rest of the work was carried out at the same level. There were no clear indicators of quality or originality of ideas.

The bibliometric data are impossible to use to assess this issue due to the large number of papers erroneously included that deal with insect neurology. The UoA confirmed that these papers were not outputs from the group. After the presentation the UoA co-ordinator delivered a corrected publications list - 65 papers were produced since 2004. The metals work and some fungal work was published in good journals, much of the research carried out by the UoA was not in high impact journals.

The group has collaborations in Vietnam, KTH, Wageningen and Macaulay.

Levels of publications, collaborations etc. are not good and do not compare well with other Schools and research groupings with which the panel is familiar.

On the basis of this evaluation, award a score from 1-6 ¹:

N.B. this is an average score and not representative of the metals work

2. Recognition and Leadership

There is no evidence that the UoA is leading the scientific debate in any of the fields in which they are engaged. The research is not pushing the envelope. Engagement with the community as evidenced by Awards, Assignments etc. (section C4.2 of self assessment document) bears this out, though we note 16 international and 10 national invitations to speak at conferences recorded by the UoA over the last 4 years (though this compares with only c. 17 conference proceedings publications listed in the publications list since 2004).

We did not probe how access to facilities was managed but assuming they are departmental facilities, the laboratory facilities listed in section C2 of the document by this UoA and the Soil C and Greenhouse Gas UoA indicate a well equipped department. Access to experimental fields and sample archives also appears to be good and should provide an attractive research environment.

There is no evidence in the UoA documents or the presentation that the UoA is viewed as an independent and trusted source of opinion.

There is a 20 % visiting professor (Dr Colin Campbell, MLURI, Aberdeen) and 7.8 researchers - it is not clear how many of these are postdoctoral fellows. PhD numbers are relatively small (4). On the plus side 3 of the PhD students are joint with other organisations (MLURI, KTH) indicating engagement with other institutions.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA **should have** the ability to generate useful data - for example their research on issues associated with organic farming should contribute to the ongoing debate regarding

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

whether organic farming is “better” than conventional farming. Their work on metal binding should generate data that could be used within risk assessment models investigating mobility of pollutant metals through the soil system. Their radioecology work should provide data relevant to continued impacts of Chernobyl on ecosystems and potential impacts of future nuclear accidents.

There is some evidence that this **potential** is realised via grants from public authorities and industry as listed in section C4.3. in the Self assessment document. Our understanding is that the SEPA and Energy Authority funding is for FOMA activities however there are grants from the UK DEFRA, EU and SSAB, LKAB which appear to truly reflect contracts with industry / public authorities.

There were no data provided on the careers of former PhD students and on questioning a vague answer was given with former students entering public authority and industry.

The issues to which the UOA **could** make a significant contribution are global. A contribution could be made in the short term. This potential does not appear to be being realized.

On the basis of this evaluation, award a score from 1-6 ³:

This score reflects what is currently being achieved and the panel's lack of confidence that anything more significant will be achieved by this UoA.

4. Strategy and Potential

The UoA has failed to formulate an “insightful, focused and ambitious” strategic plan nor, on the basis of the self assessment or presentation, are we confident as a panel of the “potential of the UoA to develop successfully”. There are some efforts at national and international collaboration - links with Vietnamese universities with shared students, joint students with MLURI, Aberdeen, KTH and a joint project with Wageningen. There was no real evidence of a strategy to recruit and develop younger faculty.

There appear to be links between Gustafsson and the Soil C and Greenhouse Gas UoA which should be developed further (see B4 below) and the potential for collaboration between Gustafsson and the Soil and Plant-Soil interactions UoA.

Of the stated Goals in section A5. of the self assessment document there is clear evidence that goal 2 - to intensify use of non-invasive spectroscopic techniques and modelling has potential. However Goal 1 - a further integration of soil chemistry and soil biology is rather vague and we have seen little evidence of integration to date and goal 3 - to continue to interact with stakeholders in research orientated questions has to be treated with scepticism as we saw little evidence for interaction with stake holders other than the metals work.

When asked how the UoA would go about boosting researcher numbers the group whom we interviewed had no idea.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The total staff profile has a good gender balance (8.4 men vs 7.5 women). The balance is skewed with women in more junior positions though the panel were pleased to note that the UoA has a female Professor. However, in the presentation it transpired that she spends almost 100 % of her time teaching. We were disappointed that she was not actively engaged in research.

On the basis of this evaluation, award a score from 1-6 ⁴:
Metals work deserves a better score

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

We have no doubt that the FOMA work carried out is to specification and producing quality data. There is evidence of recognition of this work by the funders - SEPA and Energy Authority funding linked to the monitoring of arable soils and the wetlands work respectively however it is not clear to us how competitive it is to obtain this funding. The data obtained has potentially great value both now and in the future and, in common with many UoA this should be a great strength and advantage of the UoA. However we were concerned that this UoA were not making the most of opportunities to link research and FOMA activities, for example whilst stating that the range of elements and compounds analysed in the SEPA work should be increased there appeared to have been little thought about, for example, applying for research money to make these additional measures possible. After some questioning it became clear that archived soil samples obtained during FOMA activities had been used for PhD work. There seemed to be little or no use in using data generated by FOMA activities in modeling work.

B 4. Actions for development at the Unit of Assessment

Our overall impression was that this UoA was not a viable group, and thus our strongest recommendation is to merge it with other groups. It comprised too many disparate strands with no plans for better integration. The FOMA activities were carried out competently but in isolation. The metals work had potential and is, on the basis of publications, presentation, self assessment the clearest area of strength. There seemed to be good interaction between the Soil C and Greenhouse Gas group (Berggren) and Gustafsson. We would make the following recommendations.

1. merge this UoA with Soil C and Greenhouse Gas group so that the latter group can provide leadership
2. integrate the soil-plant interactions with another group to provide leadership or cease this activity
3. expand spectroscopic methods to include state of the art microfocus and X-ray microscope methods to engage with the issue of soil heterogeneity. The key international player to engage with is the group of Gordon Brown at Stanford. Talk to the Soil and Plant-soil interaction group who are also doing EXAFS work involving

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metals

4. better integrate FOMA activities with research and obtain funding via research organisations to supplement the suite of analyses performed on samples
5. there appears to be potential for integrating metals work from this UoA with the stated need for metals expertise within the following UoAs carrying out metals work: Aquatic geochemistry and environmental chemistry, Plant and Soil-Plant interactions, Soil C and greenhouse gases.
6. we feel that Gustafsson has demonstrated great potential and that to continue to develop it is crucial for his career that he is moved to a group in which he will be provided with support and leadership.
7. we feel that to get the best return on the FOMA activities in order to integrate research and monitoring activities Lundin should be moved 100 % to the Aquatic geochemistry and environmental chemistry group

B 5. Additional information

We were interested to note that when we questioned the UoA about imbalances in the teaching load they felt this was a departmental matter which they could do nothing about.

Both the UoA and the panel were very frustrated by the highly inaccurate publications listing (and thus we assume bibliometric analysis) for this group.

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 435_5 Biogeophysics and Water Quality

B 1. General assessment of the Unit of Assessment

This UoA represents a very strong group of scientists who are active in basic research that blends in well with strong research applications. While much active research is on the basic principles of soil physics and preferential flow, this basic research is used to model transport and fate of pollutant nutrients and pesticides in soil. Their goals are to conduct both basic and needs-driven research, and they have made good progress in achieving these goals. They have been involved in 9 EU projects in the last 10 years, and thus have collaborations outside their own unit. A large focus of this unit is the 2 long-term monitoring programs. The experimental infrastructure and the wealth of data should be further utilized using advanced data mining techniques for advancing the science. This is one large hole that we identified, and that is publishing the most important papers to a wider group within the international scientific community. Perhaps their focus on needs-driven research is occupying too much of their time; new PhD students will study constructed wetlands, cover and catch crops, and subsurface dynamics and variability of P loss in a field. While these are topics needed in agriculture, these are not scientifically novel or even very exciting topics. While scaling is a stated goal of this unit, and there is an impressive level of scaling from the pore to the plot level, they could (and should) be using their excellent small-scale analyses to scale to the catchment level. They have not done this and are not yet collaborating with the aquatic sciences UoA's. With the advent of "the new building" we hope that this will foster greater collaboration than we see today. In addition, since this UoA does a great deal of monitoring, it would be ideal to see interactions with other groups abroad that do monitoring. Interactions could include comparative data analysis, but this group could contribute to analyses of how monitoring could and should be done, and solutions to common issues. This sort of analysis could put this group at the front of the international community.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific quality of the research within this UoA is very high. Jarvis and colleagues (and students and postdocs) are conducting ground-breaking research into preferential flow dynamics that has the potential to aid the models of catchment dynamics. Preferential flow is critically needed in these larger scale models to explain observed behavior of N leaching and pesticide movement, but to date preferential flow is an unknown black box to the hillslope hydrology crowd. Whilst this UoA claims they wish to scale from pore to pedon to plot to catchment to region, this is not yet being accomplished. This may be due to the fact that this UoA has focused on agricultural issues, and that the forest scientists are the ones who are supposed to focus on catchment scale dynamics. We unanimously urge this group to rethink this strategy and to work with the forestry and aquatic sciences researchers at SLU and

produce truly novel models of pollutant behavior at a large scale. The other tools and activities of this group are also excellent, including a comprehensive catchment monitoring program, with appropriate methods and techniques and a data presentation plan that is considered within Nordic countries to be a model for the rest of the world. The data mining that could be occurring with this information could potentially put SLU at the forefront of catchment science. However, two relatively minor obstacles stand in the way: the number of publications from this data is quite small, and the choice of journals used to report their science is considered to be the weakest point of this UoA. Their science is generally reported in what we identified as lower tier journals. Research that is currently published in *Science of the Total Environment* or *Vadose Zone Journal* could be in tier 1 journals such as *Ecosystems*, *JGR Biogeosciences*, *Biogeochemistry*, *EJSS*. This group has indeed published in tier 1 journals – there are papers in *Ecological Modelling*, *EJSS*, *Biogeochemistry*, and *JEQ*, but there should be more. The mind set of this UoA is slowly changing; whilst before they thought an EPA report to be critical; now they realize the need to publish in higher impact international journals. Their benchmarks were identified as Wageningen and Aarhus and UC Davis. While these may be a bit ambitious, these benchmarks are extremely reasonable goals given the scientific talent in this UoA, it is only scaling, collaboration, and most of all, publishing their excellent research in major international journals that stops them from having these benchmark units as true peers.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

As stated above, this unit could be scientific leaders in various fields if (1) publications were in better journals, and (2) they actively sought collaboration with scientists who work at larger scales, either within SLU or outside SLU. They claim that a postdoc has been hired to do this larger scale modelling so the scene is set for development of this research. They are “local leaders” in catchment analysis for Sweden; they have the capacity to be leaders in analyses of global trends in water quality. It is unlikely that much of their applied work will gain international recognition, but we did not see this as a problem provided they are continuing their basic science endeavours. In fact their work with organic farming trials *will increasingly* gain national and international attention if framed in the right hypothesis-driven framework and published in high impact journals. It is possible that the development of the “Water Hub” could create collaboration with more research-focused units that would raise the research profile of this UoA.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research of this unit seems highly relevant for the development of a more sustainable agriculture relative to water protection concerning leaching of nutrients and pesticides to freshwater ecosystems. They seem to have strong links with stakeholders (SEPA as well as agricultural organisations and authorities) and focus on transferring research knowledge gained from field experiments and model applications to practitioners. This communication

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

helps to keep their research focused and relevant for society's needs.

Examples of the relevance and impact of their research are:

- the nitrogen model SOILN was developed by this unit and is now used to calculate nitrogen loads from agricultural land in Foma activities commissioned by the Swedish Board of Agriculture.
- A most important achievement is the development of the macropore flow model MACRO that is now used in risk assessment for pesticide leaching by the Chemicals Inspectorate in Sweden, the Danish EPA, and also in the EU-wide registration process and by the Swedish Board of Agriculture to support an advisory campaign to help farmers minimize diffuse pesticide losses.
- Both these simulation models (e.g. SOILN_DB, MACRO) are used extensively by key stakeholders as decision-support tools, both nationally and internationally (i.e. EU).
- Research on 'demand-driven' water and nitrogen uptake by turfgrass has influenced industry recommendations and guidelines, leading to reduced irrigation and fertilisation on golf courses, and new products on the market better suited to this technology.
- Research on N leaching after forest fertilization using SOILN contributed to revised recommendations for N fertilization introduced by the Swedish Forestry Board in 2007. The maximum recommended N fertilization for northern Sweden was reduced.
- Long-term field experiments and observation catchments enable them to analyse and explain trends in water quality, and investigate alternative management practices and strategies.
- Research on the effects of management practices (e.g. manure handling, tillage practices) on losses of nutrients has formed the basis for new recommendations and regulations (e.g. affecting farm subsidies) introduced by the Board of Agriculture.

A larger emphasis should be given to erosion and sub-surface run-off of particulate phosphorus, since this is the major challenge to reduce eutrophication impact of agriculture to aquatic ecosystems.

Local/regional to national and EU scale.

Temporal scale of work: short-term to medium-term, but also long-term for some activities

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The unit has made modest suggestions for strategic improvement. They introduced flow-proportional water sampling at the monitoring sites, which could facilitate the exploitation of water quality data in research. In their self-assessment document they acknowledged the need to scale up, but when questioned in person there was a clear reluctance to collaborate with other units that are working at larger scales. Instead they propose limited improvements to the models that they use, that are likely not used internationally. There does not appear to be a strategy for correcting what appears to be a very skewed gender balance among faculty, however, this is true across all units, and it seems to be true of SLU as a whole.

On the basis of this evaluation, award a score from 1-6 ⁴:

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

This UoA has a strong emphasis on their FOMA activities (40%), and state they use the knowledge from their work to support policy-makers, regulatory authorities and other stakeholders (e.g. extension advisors) in their efforts to maintain and improve soil and water quality. They focus primarily on agricultural systems and do not scale to regional scales, which makes their work more appropriate for FOMA than true international scientific use. The efforts in this category seem to be effectively applied to true management issues in Sweden. They testing of their N model (SOILNDB) against catchment monitoring and demonstrated it's usefulness as a tool to analyze the effects of management practices on leaching; this work was published in high profile applied journals. They used data from models and measurements to create a P index that has been used risk scenarios for P leaching and suggested mitigation measures. This work is highly appropriate for critical environmental issues in Sweden.

B 4. Actions for development at the Unit of Assessment

Given the high effort devoted to FOMA, it is unlikely that this UoA will be able to spend the time required to conduct research that brings it leadership status on an international level. However, the effort to become a Centre of Excellence could raise the possibility of conducting truly innovative research. Their work with organic farming trials could certainly gain national and international attention if framed in the right hypothesis-driven framework and published to high impact journals, and the same can be said of their monitoring work. This unit needs to think of a strategy for making their extensive data sets better know and for publishing data mining exercises.

B 5. Additional information

The solid research and monitoring effort within this UoA and strong leadership lays the necessary platform for greater collaboration and development of systems based science at SLU. Comprehensive inter-disciplinary agricultural research has virtually dissolved at SLU, and the lack of any major synthesis efforts is potentially short-sighted, cost-ineffective and error prone. This is indicative of failure at higher levels of management and an over-reliance on FOMA activities.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 12. Soil and Aquatic Sciences

Unit of Assessment: 435_6 Precision Agriculture and Pedometrics

B 1. General assessment of the Unit of Assessment

The UoA is developing research in three areas of precision agriculture and pedometrics – improved nutrient use efficiency to reduce both gaseous and aqueous (leaching) losses of nitrogen from agricultural systems; digital soil mapping and pedometrics; and biological soil mapping with an emphasis on soil-borne pathogens. All of these areas are highly significant for improving nutrient use efficiency, productivity and profitability, and increasing funding opportunities for SLU. The UoA has good links to the Biogeophysics and Water Quality UoA and these synergies should be consolidated and promoted to ensure funding opportunities aligned with regional problems are fully exploited. The wide range of research activities and the relatively small number of researchers in this UoA is reflected in the routine nature of the current research program. Whilst the UoA is communicating with key international groups in precision agriculture, a highly focused research effort in either nitrogen or disease management, developed in consultation with key stakeholders, would provide the international recognition they seek.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

This is a small UoA with significant links to industry funding that performs solid research, but it is not trend setting. This is not seen as a deficiency, because it is consistent with the overall lack of innovation, originality and delivery in the area of precision agriculture world wide. The UoA has developed a sound research program using recognized methods (e.g. proximal sensing), interaction with other UoA's and international networking. At this moment it is not comparable to the nominated peers at the University of Sydney in the area of pedometrics, but has deserved aspirations in biological soil mapping and diagnostics of soil borne diseases with good links to the world leaders at SARDI. Increased focus on the use of NIR for rapid assessment of soil properties is noteworthy and linked to international efforts. The current geographical scope is very regional, which fits with their industry focus, but the UoA has potential for wider coverage and should associate with like groups in the EU who could also provide links to internationally recognized simulation modeling efforts (e.g. Basso at the University of Potenza). International linkages could be further enhanced through invitations to prominent researchers for extended visits.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

At this point in time, the UoA is a follower, not a leader, but has significant links to leading international groups in precision agriculture and pedometrics and the enthusiasm to develop world's best practice in precision agriculture with downstream research and monitoring impacts. Continued links to the Biogeophysics and Water Quality UoA will aid in their development and recognition as an internationally significant group in precision agriculture and pedometrics. The UoA has excellent societal links through its industry driven research efforts and has the potential for wider recognition but its progress is currently hindered through the lack of a professorial level expert, but that person should be both a seasoned practitioner as well as basic researcher.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

Stakeholder driven research. A series of research topics were presented, all of them with a potential for generating knowledge that will contribute to sustainable development of agricultural systems in Sweden: using pedometric (soil sensors) data collected from research farms and models to predict nutrient losses at the scale of a field to take variation in nutrient content and other soil properties into account. Clear interaction with the unit 435_5: Biogeophysics and water quality. Their work indirectly contributes to estimation of GHGs (N₂O) emissions from agriculture. Measuring nutrient content of organic fertilisers help optimizing the use of such fertilisers and to avoid excessive use. They measure mineral composition of soil and estimate clay proportion, which is a prerequisite for reliable estimates of nutrient-leaching to water. Disease mapping (plant pathogens) helps farmers apply the right measures (crop rotation, minimizing pesticide use). Development of diagnostic service has a high potential for commercialisation and is already supported by industry. Vision of future mapping of variability within fields to distinguish potential hot spots.

Their results and knowledge are highly demanded by farmers and farm advisory services, farmers' associations and authorities for decision- making and reports. They are all frequently (approximately 15-20 times/year in total) invited as speakers at meetings, courses and workshops arranged by authorities, organisations, universities and companies, and targeting advisors, officials, farmers and industry.

They have a conscious, strong and positive relationship with many stakeholders. They value and respect stakeholders who often provide data, experience, field research facilities and equipment contributing to their research. Locally, they are officially accepted as experts in precision agriculture to reduce the negative environmental impact of agriculture. More emphasis should be put on P-leaching from hot-spots (macropores, ditches), since this is a major threat to aquatic ecosystems.

Local/regional/Nordic scale, small, but stable activity, mainly funded from SLF
Short-, medium and long-term impact possible.

On the basis of this evaluation, award a score from 1-6 ³:

² Recognition and leadership: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

4. Strategy and Potential

The UoA is addressing highly significant research areas, specifically nitrogen use efficiency and the implications of using either mineral or organic fertilizer sources and their fate (particularly aqueous losses). The development of multi-sensor approaches to 3-D mapping requires further articulation and development, as does the implementation of diffuse reflectance spectroscopy for mapping. This UoA appears to be the only group at SLU associated with non-CO₂ emissions from agriculture at SLU. Whilst this is done in collaboration with U. of Gothenburg, it is surprising that SLU has not developed a significant interest in this area with the current favourable environment for greenhouse gas funding. The UoA has the necessary gender balance and has identified the need for a professorial appointment in pedometrics to ensure longevity and research excellence of this group. This is problematic due to the limited availability of academics in this general area worldwide, however an aligned appointment with expertise in soil science, agronomy, GIS and remote sensing would provide the momentum for developing the necessary critical mass required for breaking into the international arena.

On the basis of this evaluation, award a score from 1-6⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

The UoA has no links to FOMA.

B 4. Actions for development at the Unit of Assessment

The UoA has well developed international links and a professorial appointment will enhance the longevity and international prominence of this UoA. It is a relatively young, enthusiastic group that requires specialist senior leadership. Developing better links with groups working with geographically scalable plant-soil-water system simulation models would increase their sphere of influence. This systems based modelling has a natural alignment with this group but there is a highly fragmented approach to modelling at SLU which needs to be re-evaluated and could find a home within this UoA. Whilst the UoA has no direct FOMA work, there is potential for some of the sensor based technologies being utilized by this UoA to be used by other UoA's were FOMA is more relevant.

B 5. Additional information

Interestingly, the UoA was questioned whether it would benefit by moving to Uppsala. They rejected this idea, rightly stating that the interactions they currently have with Uppsala (e.g. Biogeophysics and Water Quality) are probably better than many of the Uppsala bound UoA's have between each other at the moment. The panel agreed with this observation and it is consistent with the high productivity and enthusiasm of the other UoA's not located at Uppsala (i.e. Soil and Plant-Soil Interactions).

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report– Part A: General Assessment of the Research Field

Panel 13. Plant Science

A. General Assessment of the Research Field at SLU

- The UoAs 330-1 and 480-1, which constitute the Plant Science research field, as judged by both the bibliometric analysis, quality of publications in high impact international journals and clear presentations to the panel, demonstrated they are delivering world class research in forest tree biology. Collectively they probably comprise the highest concentration of plant scientists in the world working on improving our understanding of tree development, physiology and improvement. They are using appropriate ‘-omic’ technology platforms and related experimental approaches.
- We found it somewhat surprising to assess these two UoAs separately from other UoAs (480_2 and 330_2) in their respective departments, as they seem to have common and complementary goals, spanning the continuum from basic to applied science, thus resulting in an unnecessarily reductionist approach. We assume they work together. This appears to be micro-management from an administration seeking to understand how to support modern, interdisciplinary research, where related disciplines must collaborate to win external funding. This could be interpreted as a failure to realize that many of the complex problems underlying plant improvement (and ultimate deployment) require an interdisciplinary approach, where significant advances are made at the interface of the disciplines, underpinned by modern technology.
- It is surprising that SLU still operates using relatively small departments, when many universities have taken the route of merging specialist groups into larger units, which facilitates interaction, exchange, management and use of core facilities.
- The panel was rather concerned that these two UoAs with complementary expertise & technologies do not appear to communicate well or often. The Departmental Heads need to meet regularly to discuss strategies for funding, and the research areas of future Professorial appointments across the Plant Sciences. There is a need to bring these units together at all levels to ensure their survival and ability to continue to contribute and compete at a world class level. The UoAs recognise the importance of this and should pursue this vigorously. Regular dialogue would allow them to develop synergies (e.g. techniques, platform technologies, -omics data, data sharing) and this will be particularly important in the progression of strategic goals in the future (e.g. sequencing the spruce genome).
- There is a need for a regular (perhaps once a year) “away-day” for the two UoAs, providing PhD students, postdoctoral and junior staff with the opportunity to present data, raise and share problems, develop collaborations and ownership of the research. Senior faculty and occasional international invited speakers would provide the vision and context for future research.
- There is a need for a formal mentoring system and assessment of early career staff to enable them to attain their full potential. Improving job security and managing career

progression of junior staff should help progression and retention, which is also vital for ensuring gender balance.

- There is a need for a common Bioinformatics platform to exploit the multitude of information being generated. Such a platform already exists at UPSC and could be expanded to serve the needs of the plant science sector throughout SLU. This could be developed to provide a web resource which is integrated with, and easily accessible by, other groups in the world's forest biology community, providing international focus for this area based at SLU.
- The common expertise in Arabidopsis, signalling, plant development, and woody plant biology provides an excellent background for the joint exploitation of spruce as a platform for improvement of conifers in general. The Uppsala group have a lot to offer, especially Sara von Arnold's somatic embryogenesis expertise and this should be used.
- We congratulate the initiative taken by the formation of Woodheads in translating scientific knowledge to the benefit of the user community in the forestry sector. We note that SweTree is the vehicle for commercial translation and look forward to hearing of practical applications in the near future. We recommend that they engage with the agriculture sector both nationally and internationally and seek expanded opportunities for further funding in this translational area.
- The work conducted by both groups appears to be very lab-based but scales well from the gene to the whole plant (i.e. "plant physiology" in its broadest sense, a term they are quite comfortable with). They need to look towards integrating information and translating to field evaluation (outside of glasshouses/phytotron), and should evaluate the potential for their basic research findings to contribute to tree improvement by carrying out larger scale field studies as soon as possible.
- Current and future plans are generally excellent and world leading, with the development of the Biocenter and UPSC. Both UoAs are concerned about the provision, maintenance and upgrading of several technical facilities, including accessible plant growth facilities, which are vital for their research. While both UoAs have been very successful in obtaining large programme grants, to obtain key core technical equipment and facilities, SLU must ensure the continuity of basic core funding at a sustainable level if they are to retain their flagship positions in the future.
- Maintenance of core equipment ('technical platforms') and appropriately trained core technical staff to operate it must be funded on a long-term basis to maintain competitiveness.
- The panel encourages further engagement with members of the public at all levels. Particular attention should be paid to engaging with politicians in general and with the Ministry of Agriculture in particular.
- These units need to begin to think about FOMA. For example, early warning systems, e.g. environmental pollution and impact on trees, possible consequences (risks and benefits) of use of clonal propagation on forestry trees, biomonitoring.
- Biodiversity, genetic diversity issues should be addressed as well as climatological issues about tree biotechnology.
- There is a need to create a dialogue with other forestry/plant production/plant protection/economics groups at SLU to make their work more relevant and also examine how this research can impact on the wealth of the country and recreation, etc.
- Both groups need to meet periodically with researchers focussed on broader issues, including climate modellers, economists, landscape ecologists, forest managers, agronomists, environmentalists; perhaps even civil servants from the Ministry, and politicians. Interactions with these, and related disciplines, would inform strategic planning of research directions and would serve to incorporate key processes

functioning at scales other than molecular and plant levels of organization. This would enhance the quality of their basic science and also broaden both applications and appreciation of the importance of their research.

- Both UoAs should put more effort into developing research collaborations and exploiting funding opportunities outside Sweden (e.g. EU, International Foundations, joint funding). There could be a larger framing issue, seeing the bigger picture, e.g. Scandinavia, Canada etc. Both UoAs should be encouraged to look for international funding opportunities in the future (e.g. international foundations).

Part B: Report on individual Unit of Assessment

Panel 13. Plant Science

Unit of Assessment: 330_1 Experimental Plant Biology and Forest Biotechnology

B 1. General assessment of the Unit of Assessment

- This UoA is carrying out outstanding research with high impact in their area, publishes in high impact international journals and has achieved international recognition for their work on extending approaches and knowledge based on Arabidopsis genomics to the establishment of poplar as a model tree species.
- During their excellent presentation to the panel this UoA, being part of UPSC, demonstrated that it has established itself as a world-leading & recognized centre of excellence in Forest Genetics and Plant Physiology by coordinated strategic planning with UMEA University leading to very significant success in obtaining a number of large programme grants (i.e. on 'soft money') from a range of Swedish funding agencies.
- The strategic plan developed by this UoA as part of UPSC shows the strength of a coordinated 'bottom up' approach coupled with excellent leadership and management.
- There is an apparent need for dialogue and collaboration with other forestry/plant science/plant protection research groups, making full use of complementarities within SLU.
- Work carried out in this UoA appears to have been successful in terms of immediately translatable work in their sector, e.g. as several patents and commercial applications (using arginine as a nursery-scale fertilizer for forest trees; the development of a novel selectable marker for plant transformation).
- The UoA has shown that their potential for increasing returns for the Swedish forestry industry, resulting in significant economic benefits for the nation. However, this potential for more significant translational benefits, based on the basic science, must be demonstrated to be pursued vigorously. Subsequent input from Edfast states that the forest industry sees a high potential for the Berzelii Centre (which has many representatives from the major industries on the board) with many opportunities for industrial application ahead. The projects within the centre have a high strategic importance for the forestry industry which is involved in many collaborative projects. She believes that this UoA has some of the strongest involvements with industry at SLU.
- Despite the excellent scientific records, the strategic scientific plan and goals need to be developed further so that they are understood by both academic scientists and commercial stakeholders.
- An apparent weakness in this UoA is the lack of cooperation with Skogforsk. Subsequent input from the UoA states 'Skogforsk is a vital partner for us in our expansion towards natural variation in spruce, EST and whole genome sequencing and the use of molecular markers for conifer breeding. Also in the somatic embryogenesis project and the project with elite hybrid aspen trees Skogforsk is supplying us with clonal material. Skogforsk has been very positive to our initiatives in these areas and we

anticipate that our collaborations will be even more intense in the future in bridging the gap between molecular genetics and quantitative genetics/tree breeding.'

A significant threat for future translation and deployment based on a transgenic approach to tree improvement by this UoA is the lack of understanding and adverse attitude of the general public (encouraged by NGOs). This cannot be dismissed by hoping that it goes away, but must be addressed by the public involvement of all members of the UoA in debate at the national level. We formed the impression that this UoA was rather dismissive of this aspect which should not be underestimated. Subsequent input from the UoA suggested that they had a very active programme of public outreach.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- The outstanding publication record, not just in terms of tier 1 journals in the field, but also in the highest impact general journals (Science, Nature, PNAS) is impressive.
- The panel is concerned about the apparent lack of collaboration with other departments/UoA's in SLU, suggesting a rather insular approach. Based on the written evidence and presentation by the UoA we formed the impression that his UoA could markedly improve this perception and show more leadership.
- We congratulate the UoA on the step-change in quality, trajectory and impact of the research activities of the UoA around 2000, coinciding with the start of UPSC.
- This UoA obtained world-wide visibility by genomic sequencing of poplar coupled with exploitation of this information. It must ensure that this resource and the reagents generated from future research are made available to the scientific community soon after publication to ensure these data are in the public domain to allow full sharing and exploitation of these important data sets. The current challenge is to build on reproducing this information for spruce, as this will be the first model conifer.
- The UoA appears to be well coordinated internally, and also fully integrated with the University of Umeå. To make better use of resources (both technical and intellectual) within SLU the UoA must ensure that this sort of relationship is tri-partite with Uppsala.
- The UoA recognizes the logistical problem associated with Umeå being far north and thus viewed by some as not an attractive location for PhDs/students. If so, this question needs thorough discussion, consideration and remedial action.

On the basis of this evaluation, award a score from 1-6¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

- Partnership with University of Umeå has been very successful in building this UoA.
- The UPSC functions very well as a team and the technology platforms developed are available to all researchers in this UoA, which is important for the maintenance of the scientific leadership. However, the panel felt that UPSC needs to extend their partnership and scientific interaction/research discussions with other units/departments of SLU. Although leading in their field, this UoA seems rather insular.
- This UoA has perceived jealousy of their success from other departments. This needs to be tackled by both them and SLU, and their success used in a positive way to encourage other UoA's to develop in similar ways.

Benchmarking, the approach with “tree-omics”, plant biology and tree physiology are all important. However, only part of forestry is represented in their portfolio. The panel got the impression that this UoA is not communicating enough to other people in higher levels of organizations, other departments or UoA's. The UoA subsequently responded ‘We have excellent connections to the very top levels of the Swedish forest industries, the biggest Swedish NGO on environmental protection, the boards of agriculture and forestry as well as to the ministries of agriculture, trade and industry. We have been visited on several occasions by the vice prime minister and minister of industry, that during her last visit brought the Norwegian minister of energy and industry to introduce her to the UPSC concept and potentials. During her last visit to Brazil, the vice prime minister and minister of industry mentioned UPSC in all her discussions with the president of Brazil and other top ministers as being one of the research institutions in Sweden with the highest potential for Brazilian-Swedish exchange. Also the ministers of education and EU relations have visited several times. In a recent debate article the minister of agriculture pinpointed UPSC as being one of the environments especially worthy of increased support from the government based on its high quality research and strategic importance for Swedish forestry and agriculture. Several CEO's and vice CEO's of the big Swedish forest companies have visited UPSC. Some on several occasions!’

- Evidence of recognition of success is that leading scientists in this UoA (Björn Sundberg, Ove Nilsson, Göran Sandberg, Torgny Näsholm, Gunnar Wingsle, Rishi Bhalerao) have been acknowledged with prizes, honours, positions of trust and are to be congratulated.
- This UoA has a good record and approach to support early career development financially & provision of running costs to PhD students. The panel felt that the approach of students reporting directly to the board of UPSC is good.
- However, there is a need for some scheme to ensure mentoring and professional development; this is crucial to encouraging and retaining the next generation of research scientists.

On the basis of this evaluation, award a score from 1-6 ²:

2. Relevance and Impact

- This UoA has a rather heavy emphasis on basic research and publication is highlighted appropriately in their self-assessment. This is critical, but more is required to achieve translational relevance. The panels concern about this apparent focus on basic research alone was completely resolved during the interview, where we learned of the UoA's constant attention to translational opportunities and creation of a pipeline (Woodheads to SweTree) to accomplish such.

² *Recognition and leadership:* 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

- This UoA is concerned about problems with encouraging younger people to be interested in plant science. There is a need to present research in a different way, for example, establishing a dialogue in various areas, including the public and government. Public understanding of science is an important issue that needs to be recognised and addressed. This includes involving teachers and other community leaders in communication, debates. We suggest the formation of a small group (post-graduates, postdoctoral and young faculty scientists), as a working party to develop these discussions and means to implement (e.g. producing a booklet, initiating a web-based blog, perhaps along lines similar to that produced by the UoA 480_1 at SLU).
- Interaction with industry seems to be very good. We commend the initiative in developing lines of communication with a broad range of industry in Sweden.
- The filing of many patents from this UoA is a strong point. Two of the patents have so far produced new products that are actively used by the industry; SELDA: A selectable marker gene replacing antibiotic resistance markers that is now the standard marker within BASF Plant Sciences being used in the development of most of their genetically modified crops. ArGrow is the new environmental-friendly fertilizer based on organic nitrogen which is being used both nationally and internationally. Considerable follow up work and cooperation with industry will be needed to enable commercialization of transgenic patents.
- The UPSC needs to have forestry experts coming in to tell them what is required by the industry. They need to improve their dialogue with industry to find out what the industry needs and obtain joint funding and field evaluation of science-based improvements.
- Working on coniferous trees is long-term, which is different from the work with *Arabidopsis* and also *Populus*. Working on trees that reach early reproductive maturity could be extremely important.
- Nutrition is very important for nurseries, so the patent regarding use of arginine as fertilizer is an important practical and applied finding which should be exploited fully.
- Impacts are mainly national (i.e. Swedish) to date. The UoA could do better at the international level through interaction with professional bodies and agencies (e.g. IUFRO, EU, etc.).
- The UoA should be interacting and contributing to the debate to influence government at the highest possible level (e.g. Royal Academy of Forestry & Agriculture).
- The UPSC has been very successful in building its research in the last 10 years, but a weakness is that it is all built on soft money. The scientific goals are now focused on spruce, but a key question is: how will this work be financed? The panel thinks it will be difficult to fund this project on soft money, and ways to look for core funding from Umeå or SLU should be investigated urgently, or this proposed new venture may fail from a lack of resources.
- Relevance and importance is very good. This area of research is of very high importance in Sweden and world-wide. The trajectory is good and shows great promise for the future.

On the basis of this evaluation, award a score from 1-6 ³:

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

3. Strategy and Potential

- This group should be held up by SLU as a model for how basic research can underpin and lead to success and progress in applied science. Much fundamental, basic work has already been achieved and will support success in the future. This UoA is on a good trajectory. However, there are several issues that may be a threat for future progress to this UoA.
- The UPSC has been very successful in building their research over the last 10 years. However, as already noted, a considerable weakness is that it is all built on “soft” money (programme grants for large scale facilities and equipment). Thus, although this UoA is performing extremely well currently, their reliance on soft money for supporting their technical platforms is a major threat. The panel thinks that core funding to maintain and update technology platforms is crucial for future success to ensure that this UoA does not fail in this next step towards future success. There is an obvious pressing need for university investment in their facilities if they are to maintain and consolidate their leading position in their area. To sustain the research and maintain expensive core equipment/facilities, SLU and Umeå will need to commit to a scheme to allow these technical platforms to continue operating in the absence of large amounts of external funding. This is especially important in the current economic downturn, as the level of external funding sources is likely to drop. A mixed funding model could be looked at, comprising core funding to develop out of soft funding, plus soft funding to expand existing areas etc.
- Modern science is expensive and needs to be integrated with other areas of science to move to real systems biology. A “Phenomics” approach, such as those being developed for major cereal crops should be considered.
- There is a need to maintain and continue to develop the UPSC. Collaboration worldwide appears good, and is being actively pursued via funding from VINNOVA. We perceive that it could be improved by additional interactions and visits between other institutions worldwide. We did not see much evidence of synergies or collaboration between this UoA and other groups at SLU. Where appropriate this is important to achieve the full potential and exploit the wide range of skills of your staff. Science has moved into a much more multidisciplinary operating arena, and interactions and co-operation are critical for success. The lack of interaction, with, for example, the other UoA we assessed (480_1), which includes research on trees, is surprising. They are missing an opportunity here.
- There has been significant investment into developing research in spruce. We do not underestimate the importance and challenges associated with developing spruce as both a model system and a real and relevant conifer, not just a model. However, many other labs internationally have realized this, and are moving to spruce as a model. So, there is a significant potential threat of competition world-wide on the horizon.
- We did not hear much about strategies for the future. This UoA has established a model that works (*Populus*), and are sticking with it and moving it into another species with very different properties (spruce: evergreen, will have new, different genes, wood structure, and pests).
- Spruce is closer to being a ‘wild species’, not domesticated. The potential to explore and preserve diversity has been realized as an approach (common garden experiments to be started). However, if it is decided to go clonal (as is likely for forestry applications), using this approach would result in diversity being lost and the potential for the associated genetic vulnerability increased. This UoA must think about possible future approaches in relation to these issues, and address them. We are rather concerned that this UoA is not looking forward enough to maintaining diversity (or is this aspect

covered by another UoA?). On a related point, this UoA should be more concerned about the real problems facing forestry today. For example, loss of genetic diversity, climate change and environmental issues, which are huge issues facing the sector world-wide. Understanding patterns and control of growth phenology in trees and other perennial plants is crucial for modeling forest response to climate change, and towards development of strategies for adaptation (e.g. assisted migration). They have made major progress in terms of the basic biology, but does this UoA have anything to offer towards solving how these issues impact on future forest ecosystems and the industry? They should be thinking tactically towards these as it is of both industrial and public interest.

- The gender balance is currently poor, and the UoA recognizes this. Development of a tenure-track system (see later; section B5), could be crucial for addressing this problem.
- The UoA was very concerned that there was no Forestry stakeholder expert present on the panel (absence due to illness). However the panel consulted the expert and since this report was first submitted has received input by email.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

- The panel felt that this UoA has potential in the area of FOMA to produce screening tools for monitoring changes in the forest environment.
- The University should consider setting up a cross-departmental working party to obtain information of what is required by FOMA. This will enable SLU to better develop an appropriate and coherent response to develop strategies to provide the monitoring assessment required by the Ministry.

B 4. Actions for development at the Unit of Assessment

- We recognise that the UoA has established a good working relationship with industry and would encourage them to develop a mutually beneficial dialogue with other forestry units both at a national and at an international level.
- The Advisory group in the Berzelii Centre includes high level scientists involved in carrying out basic science and representatives from the largest forestry owning companies in Sweden. We would encourage the involvement of working, applied scientists from an industry-based background.
- This UoA comprises a unit (UPSC) that has leaders in science, and that should act as a model that others might wish to emulate, with success in breaking into more applied work. However, the senior faculty members now need to show this leadership in other ways; e.g. by organizing Gordon Conferences, other international meetings, etc; thereby contributing to the wider community as a whole, at an international level.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 5. Additional information

- While we recognise that this UoA cannot cover all aspects of Forest Biology but suggest that added value may be realised by interfacing with researchers working at other levels of biological organization. This is particularly important given their emerging focus on another tree species (spruce). Strategic discussions with climate modellers, biogeochemists, ecosystems scientists, community ecologists, and pathologists would serve to inform decisions about research directions. This will allow them to address questions of biodiversity, forest pathogens, and ecosystem services other than simply biomass and fibre production.
- We identified a need for a formal staff mentoring system in order to allow young staff to develop to their full potential. Given the investment in talented staff, and recognition that they need help to get their independent careers started (the University already provides a PhD student and some running costs), a mentoring system makes sense. We believe this is extremely important to the development of the next generation of group leaders. Additionally, this may also help the gender imbalance, encouraging women to overcome hurdles during this stage of their career, thereby increasing the number of young women who make it to professorial level.
- We recommend that SLU & Umeå look at models of how to provide core funding/facilities (perhaps inter-departmental, i.e. providing core facilities to larger groups) to facilitate successful research through provision of good infrastructure. This could also encourage more collaborative projects and broader, larger projects. This is essential for future success.

Part B: Report on individual Unit of Assessment

Panel 13. Plant Science

Unit of Assessment: 480_1 Molecular Plant Biology

B 1. General assessment of the Unit of Assessment

- This group has established an international reputation in specific research areas, including plant development and plant defence, as confirmed by the bibliometric assessment of publication in high impact international journals.
- Although this is a strong research group, they could improve their internal integration by creating a more focused critical mass of individuals in key areas of research and through collaboration with other UoA's working on plant production, plant breeding and plant protection.
- This UoA is successful in obtaining funding from competitive Swedish sources, but should strive to diversify their funding (e.g. additional collaborative funding from the EU framework and other international sources). This would serve to improve their visibility and would also consolidate their international position and reputation.
- We welcome the impending recruitment of three new professors to this relatively recently constituted group, and hope they contribute to developing the critical mass needed to sustain cutting edge research within their existing areas of excellence. The intended areas of expertise are appropriate to obtaining focus and critical mass in key areas, but care should be taken to ensure that appointments meet these criteria.
- We support the desire of this UoA to develop strategies for crop improvement with industrial partners. However, this will require the establishment of a dialogue with national and international agricultural sectors in order to identify the science needed to address stakeholder priorities. They should seek to emulate the type of successful relationship already established with the forestry research institute (Skogforsk), SweTree, and SAMBA.
- This UoA is commended for their activities related to crop improvement in developing countries, but this research could be better integrated into their core mission.
- We welcome the establishment of the BioCenter, as it will facilitate interactions and cross-disciplinary approaches to understanding and developing the sustainable production of renewable natural resources in the face of biotic and abiotic stressors. It is critical that this UoA contribute to a transition team focused on developing a coherent strategic plan to exploit and realize the full potential of this new consortium of research expertise and facilities.
- The NL faculty must recognize the importance of providing significant contributions to the budget for platform maintenance and sustained technical support for this UoA and the BioCenter. For example, provision of plant growth facilities (especially the phytotron) and confocal imaging are critical needs, without which this research group cannot perform their research.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - Research1. Scientific Quality

- This group is recognized internationally, and international recognition is high for some individuals within the UoA. Collectively, they have an impressive number of publications in high impact, peer-reviewed journals.
- Despite the recent losses of Faculty from members of this research group in this UoA, and the current state of flux it is in, they have a promising research profile with respect to quality and impact, and importantly, a vision for the future. The UoA carries out some scientifically very exciting research, but the scope is very broad and perhaps too ambitious. They need to develop critical mass in certain key areas in order to have an impact at an international level.
- We welcome and applaud the decision to appoint three new professors to this relatively young group is a crucial strategic action, and we hope they contribute to developing the critical mass needed to sustain cutting edge research within their existing areas of excellence in the UoA.
- Value could be added by establishing more international collaborations. There are several areas of research carried out by this UoA that have internationally high profile (e.g. Plant-pathogen interactions, programmed cell death, cell signalling). Interactions and collaboration with other labs carrying out this research could provide higher impact at an international level. This approach could also lead to formation of international networks and perhaps EU funding.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

- Two senior professors in this UoA are recognized international leaders. Continuation of this excellent position will require succession planning and younger members of this UoA need to be groomed to be able and ready to fulfil this leadership role.
- Recent losses of faculty staff leave this UoA currently in a state of flux. However, their promising research profile, a recent new appointment, and the commitment to further faculty appointments should allow them to begin to think about leading the scientific debate in the future.
- Members of this UoA have been initiators or participants in a number of national networks (e.g. the high profile Salix Bioenergy group). This is to be applauded, but this leadership should be extended to an international level if they are to be recognized world-wide as leaders in scientific research. This is especially important with respect to the research areas of development and plant-pathogen interactions/defence, which is their intended major focus.
- This UoA have developed a reasonably strong PhD mentoring system.
- Support for Assistant Professors is good. Mentoring and advice in career development plans should be better developed in order for new faculty to fully achieve their potential (see **Section B5**).

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

- This UoA is an important player in capacity building and consultation in plant science nationally and contributes at an international level in a number of key areas. It is attempting to intensify national and international collaborations.
- This UoA plays an important role in educating young scientists, who later get positions in the government, HEI, as well as the private sectors. The UoA is very active in teaching which is an important societal undertaking and should be acknowledged when considering career advancement.
- Interaction with society is strong, as exemplified by advisory consultations to several Ministries. This UoA is committed to collaboration with developing countries, but there appear to be no contracts with Swedish authorities or Swedish industry. The number of PhD students paid by industry or grants from industry is zero. This could be improved upon.
- This UoA's scientific achievements include both basic and applied fields of research that could involve industry (spruce embryogenesis, programmed cell death, starch synthesis, glycoalkaloids). In particular, applied research should preferably be linked to end-users. The panel was given the impression that this UoA informs stakeholders about their activities, but not through an interactive process involving two-way dialogue. This needs to be remedied. The panel noted that the UoA has involved new stakeholders in common research projects and established good links with the forestry industry through collaborations with Skogforsk and SweTree. This is an important requirement for successful implementation of important future activities for contributing to developing society, and is promising.
- Development of methods and expertise in somatic embryogenesis and early flowering of spruce and collaboration with the tree breeders are of great importance, and provide opportunities to accelerate the breeding of spruce which with traditional selection and breeding protocols is a very slow process. However, in general, from a stakeholder's perspective the breadth of the interests of this UoA is a weakness. They need to focus, as this breadth does not make this UoA attractive as a collaboration partner.
- From an agricultural industry stakeholder's perspective, contacts, dialogue and collaboration with crop plant breeders and enterprises are missing. This aspect should be enhanced in order to develop the societal relevance and impact of the UoA and make them attractive as a partner for collaboration. The panel recommends that the UoA proactively develop contact with national and international agro-industries and explain their research objectives and achievements with the view of obtaining funding for both basic and applied research and cooperative PhD studentships. Such joint ventures should also open the way to evaluation of improved crop plants in the field with the industrial partner. The SLU 'Future Agriculture' programme, involving transfer of scientific knowledge to developing countries and the Swedish tree breeding industry may provide the opportunity to develop this recommendation.
- The strategic focus of this group is in the area of plant development and defence. The study of plant-pathogen interactions is an important focus for research, but is a highly competitive area, with many groups worldwide working on this topic. It has potential for applications (resistant crops), but this is quite long-term, and also probably is dependent on GM being acceptable to society.
- We did not see much about the genetic diversity/QTL research, but this area has potential for the future, especially if GM is not acceptable to the public.

² *Recognition and leadership:* 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

- Members of the UoA have been active in consultations and knowledge dissemination both at national and EU level.
- This UoA has been nationally active in public lectures and debates, blog-writing and discussions of scientific questions, and advice to government.
- The UoA has a respectable programme of collaboration with relevance to developing countries-postgraduate student training with funding from SIDA.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

- This UoA has developed expertise in the study of plant development, defence mechanisms and genetic diversity, working at genetic, cellular and molecular level.
- The recent appointment of Benedikt Kost to this UoA is a sign of recruitment of promising new faculty with good publication record and reputation. However, his research does not match the major research themes for this UoA and his research needs to be integrated into the research focus of the group for him to be an effective member. This aspect needs to be borne in mind when further new appointments are made, so that critical mass and focus in areas of strategic areas are achieved.
- New synergies, in terms of scientific expertise and technical facilities, can be expected to arise within SLU departments in Uppsala as the new BioCenter starts operating, enabling research groups to communicate better by being physically located nearer to each other.
- Work to exploit the possible synergies which will be created by the BioCenter as a focus for research activities must be initiated immediately by the formation of a working group from all interested parties to identify joint research opportunities and to prepare project proposals for funding.
- Consideration should be given to further development of a metabolomics platform linked through to plant physiology (e.g. systems biology) by the appointment of a suitably qualified candidate to one of the new positions and/or collaboration with European partners who are experts in the field.
- Dialogue and collaboration with crop plant breeders within SLU and industrial stakeholders are missing and should be initiated (see 3 above) which in the long run may lead to discoveries that can be commercialized.
- As a matter of urgency the panel suggests that dialogue and collaboration with UPSC is increased significantly, at all levels, in order to realise the maximal benefits of the expertise, facilities and technical and bioinformatics platforms that have been developed/are developing within SLU. The formation of a joint working party (to include collaborators from Umeå University) towards this end, reporting back to both departments by the end of the summer, may be a first step forward.
- The issue of a new Phytotron being missing from the new BioCenter needs to be urgently addressed. Without this facility within the BioCenter much of this UoA's research is at risk. To avoid similar problems in the future, forward planning for any new developments should involve faculty staff being involved in strategic planning.
- Gender aspects: Currently, gender aspects in this UoA appear as being on a 'healthy' basis. However, with the retirement of two female faculty in the near future, this needs

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

to be kept in mind when new faculty are being recruited. In future appointments, the competitiveness of the applicants should, however, be the key selection criterion.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

- The University should consider setting up a cross-departmental working party to obtain information of what is required by FOMA. This will enable SLU to better develop an appropriate and coherent response to develop strategies to provide the monitoring assessment required by the Ministry.

B 4. Actions for development at the Unit of Assessment

- This UoA is keen to obtain international funding. SLU should provide administrative support in constructing and developing EU and large collaborative grants involving several institutions and/or countries. SLU should also help in identifying calls for funding and bringing appropriate contributor applicants together to discuss possibilities early in the process.
- There is a risk that decisions are taken regarding the three new professorships just within this department, and without much involvement of the plant science group as a whole. Large strategic decisions like this should be looked at from a higher level perspective.

B 5. Additional information

- We identified a need for a formal staff mentoring system in order to allow young staff to develop to their full potential. Given the investment in talented staff, and recognition that they need help to get their independent careers started (the University already provides a PhD student and some running costs), a mentoring system makes sense. We believe this is extremely important to the development of the next generation of group leaders. Additionally, this may also help the gender imbalance, encouraging women to overcome hurdles during this stage of their career, thereby increasing the number of young women who are retained at tenured professorial level.
- Although we have scored this UoA highly, there are a number of critical aspects that need to be noted if this UoA is to maintain and exploit its promising position. If suitable investment by SLU and focus are not achieved, this UoA could be in danger of losing the significant international reputation it has established. SLU should note this when considering funding choices between UoA's. In particular, the issue of a new Phytotron being missing from the new BioCenter needs to be addressed immediately. Without this facility within the BioCenter much of this UoA's research is at risk. It was unclear to the panel what confocal microscope facilities currently exist at SLU accessible to the UoA 480_1. We recognise that provision of this facility is absolutely necessary to their research.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report – Part A: General Assessment of the Research Field

Panel 14. Genetics and Breeding

A. General Assessment of the Research Field at SLU

Genetics and breeding is the foundation for the sustainable development of Sweden's agricultural and forest resources. Sweden has a long history of innovation and leadership in plant and animal breeding. Geneticists and breeders are internationally recognized as intellectual leaders. In addition to the scientific and intellectual capabilities, Swedish citizens have benefitted from plant and animal improvement. Healthier and more productive food crops, animal herds, and forest stands are the direct result of Swedish breeding contributions. Following are specific points the panel wishes to convey:

Overall Strengths

- The overall quality of the UoA's was very good, although there was significant variation.
- Many fruit and forest crops are special for this area of the world. Genetic activities are particularly relevant for the Nordic region due to long day length and unique growing conditions.
- Research required for this area of the world is also relevant internationally.
- The internationalisation approach demonstrates Swedish leadership in education and training of scientific leaders throughout the world.
- Publication record range from good to outstanding, both for quantity and quality.
- We applaud the development of the BioCenter as an example of strategic infrastructure investment.
- The animal genetic group (670_1) is an example of development and integration of modern genetics. There should be a similar approach for plant genetics.
- We concur that a comprehensive undergraduate educational program is critical for the success of SLU research.

Challenges and Suggestions for Improvement

- Distance among campuses and the administrative divisions create impediments for networking, cooperation, and communication. Given these challenges, collaborations are ongoing but could be strengthened.
- Except for forestry, the Swedish breeding industry is not large scale. There should be more collaboration with industry. Good examples of collaboration with stakeholders were demonstrated in Horticulture (fruit and berry breeding) and in Animal Genetics and Bioinformatics (dog breeding).
- Sustained, long-term funding is required especially for breeding and perennial genetic resources.
- We observed substantial international collaborations, recognition, and stature, but coordination needs strengthening to improve access to EU and international funds.
- At this moment, strategic planning is urgently needed in the replacement of retired professors and scientists. These new replacements need to have competence in emerging

technologies.

- We have identified the need to establish a research continuum starting from basic science through genetic resources and breeding. We are convinced that vibrant basic plant science is a prerequisite for rational breeding.
- We recommend regular (semi-annual?) meetings of the SLU genetics community to discuss and review technological developments, new scientific advances, and new challenges.
- The committee found the bibliometric analyses confusing. A brief CV of each scientist would have been helpful to the committee as well as more information regarding research organisation.

The review panel was impressed by the overall quality of genetics and breeding units, and we are optimistic about the future of SLU.

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 330_2 Forest Genetics

B 1. General assessment of the Unit of Assessment

Forest Genetics is the foundation for the sustainable management of the genetic resources of forests. Approximately 60% of Sweden's land base is forested, so the significance and value of this UoA cannot be overstated. Forest Genetics has a long history of excellence in Sweden and at SLU. The professors, scientists, and students have well-recognized, international reputations as leaders in the field.

Breeding long-lived organisms that must deal with enormous spatial and temporal environmental variation is a challenge that tree breeders face. In Sweden, the rotation lengths are very long, 50 to 80 years in the south, to well over 100 years in the north. Scientists in the UoA have been key leaders in developing breeding strategies and production systems that result in significant genetic gain in planted forests while maintaining the appropriate amount of diversity to deal with current and future environmental uncertainties and risks.

The UoA has had major influence on tree breeding programs throughout the world as evidenced by their co-authorship in the list of publications. Additionally, the education and training of PhD tree breeders and forest geneticists has been excellent.

Unfortunately, the forest genetics at SLU has declined. Both personnel and support for the UoA has shrunk to about 40% of what it was 20 years ago. The PI stated in his presentation that no big projects have been started since 2003. While the scientists have had good collaborations with other traditional tree breeders, the lack of collaboration with scientists in disciplines such as molecular biology, genomics, physiology, as well as with scientists in other disciplines of forestry was very apparent, and the program has suffered.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The scientific quality of the work has been generally good. The modeling efforts to understand the tradeoffs between genetic gain and diversity have helped to drive and direct tree breeding programs throughout Sweden and the world.

The publication record has been good, both in numbers and the quality of the journals. We felt that the bibliometric profile was misleading as far as the journal impact score (NJCS) was concerned. The forestry journals where most of the authors' works were published do not have high overall scientific impact scores, but in the discipline of forest science, these are the best journals in the field.

In recent years, the scientific quality and significance of the UoA has somewhat declined. While the publication record in the traditional areas of forest genetics has still been strong, there are fewer publications (about 10%) in the areas of molecular genetics/genomics, physiology, or other forestry disciplines.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The scientific leadership has been strong in the past but has dramatically deteriorated in the last 10 years. The PIs admitted in the discussion with the panel that *the five forest geneticists in the group have never sat around a table and discussed common matters*. This comment had a very negative impact on the panel.

The panel felt that the numerous opportunities for collaboration (e.g. physiologists, molecular geneticists) have been missed.

Other evidence of leadership problems are that all of the scientists are either retiring, partly retired, are departing, or are only partially employed. The panel is very concerned that the attractiveness of the research environment is poor.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The panel feels that if a high-quality scientist with strengths and capabilities in the traditional areas of forest genetics and in the more basic and emerging genetics fields can be recruited, then the UoA can be reinvigorated and regain international prominence. The potential of this UoA is unlimited given the opportunities for collaboration with other breeders at Skogforsk (the Forestry Research Institute of Sweden <http://www.skogforsk.se/>), at institutions around the world, but in particular with scientists in other genetics disciplines at SLU.

If the appropriate genetics team can be put into place over the next months and years, the panel feels that the potential for influencing Swedish, Nordic, and global tree breeding is unlimited. Forest genetics is a small scientific discipline, so an effective, productive, energetic, and enthusiastic research team in Sweden could have enormous influence for years to come.

On the basis of this evaluation, award a score from 1-6 ³:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

The value and significance of forest genetics in Sweden has been recognized by SLU, as evidence by the international search for a Professor of Forest Genetics that is currently underway. The panel agrees that UoA 330_2 is critical for Sweden's future (see comments in B1), and we are confident that the program can be reinvigorated and gain high international stature. However, a high-quality, high-impact program in forest genetics is dependent on the recruitment, maintenance, and support of an outstanding scientific team. In recent years, the development/recruitment of younger faculty has been only partially successful.

Numerous opportunities exist for collaboration with foresters and breeders at Skogforsk and with other scientists at SLU. Success of the new team depends on their ability to foster, maintain, and enhance these collaborations.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

Hiring the new professor is by far the single most important factor for the future of the Forest Genetics UoA. This person must be a well rounded breeder / geneticist who is open to working and collaborating with scientists and stakeholders in the various disciplines that we have previously mentioned. The mission of the UoA is very well described in the self assessment document:

“Forest Genetics is the Scientific foundation for sustainable management and improvement of Forest Genetic Resources. The Study of Forest Genetic Resources is a key factor for the future of Mankind.”

With the appropriate new research team, we are confident that forest genetics will be advanced at SLU, Sweden, and throughout the world, and this mission will be accomplished very well.

B 5. Additional information

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 480_2 Genetics and Plant Breeding

B 1. General assessment of the Unit of Assessment

- General assessment of the UoA:

The Genetics and Plant Breeding Unit (UoA 480-2) is a component of the Plant Biology and Forest Genetics Department affiliated with the Faculty of Natural Resources and Agricultural Sciences. Based on submitted information and the oral presentation, it was clear that this unit was tightly integrated with the Molecular Plant Biology Unit (UoA 480-1) forming a cohesive combined group. It was thus somewhat difficult to evaluate the UoA 480-2 in the absence of UoA 480-1. The Genetics and Plant Breeding Unit (hereafter referred to as ‘the unit’) research program is organized into three main themes: development, diversity and defense and involves both applied and basic aspects of plant and crop genetics. Increasing emphasis is being placed on the use of emerging technologies, including genomics, in addressing relevant biological questions. A defining strength of the unit is its expertise in the analysis and exploitation of genetic diversity. An example of this approach would be the development of molecular markers for germplasm enhancement. Thus, the unit could be viewed as an emerging core group that promotes collaborative support to breeding and commercialization programs. Unit members are currently studying a very broad variety of trees and crops, including tropical crops such as cassava. This is an ambitious approach that warrants on going assessment so that the materials under study (and the data ultimately generated) do not become unmanageable.

- Multi- and interdisciplinary activities:

The unit members are interacting with other organizations and networks, including members of Uppsala University, and the Royal Technical College in Stockholm. Multi-disciplinary projects with other SLU faculties include the field evaluation of *Salix* germplasm with the breeding team at Alnarp. The unit is internationally recognized for its research and has published widely in the last four years, including papers in high impact journals (i.e. *Nature*, *Plant Journal*).

The unit presentation to the evaluation team was very well planned and informative, providing a long term future vision. The four representatives expressed enthusiasm and optimism in relation to the long term direction of the unit.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

In general, the unit has demonstrated the capability of generating high quality research as evidenced by the publication productivity and external funding received through a highly competitive grant selection process. There is variation in quality of papers and impact factor

of the journals chosen for publication. Publication content ranges from classical field analysis to advanced biology and genomics technologies. Examples of quality research projects include, but are not limited to, the development of high density linkage maps in *Salix*, the development of *Arabidopsis* as a model for studying blackleg disease in canola, and the nuclear/cytoplasmic characterization of floral organogenesis. It would appear that with time and recruitment of new staff members, there is an increased rate of adoption of genomic and related life science technology to address complex research questions (e.g. flowering, host-pathogen interactions). The unit members are aware of new programs and have developed new research initiatives to gain support for these programs.

- Geographic scope and quality of academic networks and collaborations

Unit members are key players in a number of important national networks/initiatives including the Uppsala Centre of Plant Evolutionary Biology, the Uppsala spruce genome platform, the Swedish PCD platform¹, the national program on blight resistance breeding in potato and the *Salix* bioenergy program. The unit is involved in a number of international projects with developing countries including collaborative research and/or training agreements with Nicaragua, Uganda, Vietnam and China. The unit has also become a successful co-applicant in an ERA-NET genomics project that involves at least 3 European nations.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

- Ability to lead the scientific debate and provide an attractive research environment

The unit has established a dynamic environment involving the pursuit of new projects (eg. ERA-NET) involving the application of new genetic technologies, which should be further facilitated by the recent recruitment of two new assistant professors. Graduate students are active team members, participating in regular seminars and international training courses (eg. Cold spring Harbor). Senior members are participating in seven national multidisciplinary programs. In addition to participating in international graduate student training initiatives, unit researchers have established lines of communication and interaction with a range of private sector organizations. This has resulted in the establishment of the *Salix* bioenergy project involving a company and the agricultural crop breeding group at Alnarp. Thus there appears to be a positive general environment conducive for creative research as well as for collaboration with other groups.

- Broader role in society as an independent and trusted source of opinion.

The unit demonstrated its commitment to effective communication with the stakeholders and the general public. A full time staff member has been employed to pursue important policy and communication issues including the role genetic modification technologies and significance of genetic resources and biodiversity. An interactive web site has been established and is successfully engaging Swedish citizens in dialogues on relevant "bio" issues.

On the basis of this evaluation, award a score from 1-6 ²:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

3. Relevance and Impact

The unit has the capability to make significant basic and applied research contributions. There is a substantial commitment to research on the fundamentals of fungal pathogen interactions with host plant cell/tissues. This knowledge could contribute to enhanced crop yield with reduced fungicide inputs (e.g. Blackleg in canola, potato blight, diseases in Salix). The recent research collaboration with industry on bioenergy crops (i.e. Salix) could contribute in the long term to sustainable supplies of bioenergy and environmentally friendly bioproducts. Unit members are also actively considering research initiatives relevant to the impact of climate change on Swedish agriculture (i.e. Crops for Future Needs Program). The ongoing and planned projects in international agriculture could contribute to enhanced yield of key staple crops in the developing world (e.g. cassava).

This UoA is well positioned geographically to provide strategic collaborative support to the more applied initiative being pursued at Alnarp, Umeå and Balsgård. Large scale, collaborative genomics projects can be pursued through previously established cooperations at Uppsala and Stockholm. The unit is well connected with ongoing and proposed Swedish and Nordic region initiatives. The unit could be challenged to strengthening relationships with other EU countries as well as reaching to other jurisdictions (e.g. Canada, USA).

The unit has provided a long term vision, which involves building on established strengths. This will be aided through relocation into a new facility in 2011, but will require new staffing actions and sustained/enhanced resource allocations to achieve full potential of the unit.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

- Areas of high and realizable potential

The unit has clearly indicated a desire to strengthen basic and applied research in plant production, diversity and defense. If strategically focused, the unit will be capable of making significant contributions in terms of socio-economic benefits for Sweden as well new contributions to knowledge that are internationally recognized. In order to achieve its strategic goals, the unit will clearly need to build on existing collaborations as well as establish new collaborations. The evaluation team believes that the unit could position itself on the more innovation basic end of the spectrum ensuring the rapid and effective adoption of new/emerging technologies. It is recognized that some applied activities will be required to facilitate with technology transfer and collaboration breeding initiatives in both the public and private sectors. Key future areas of expertise, (some already recognized by the unit leaders) should include genomics, bioinformatics, metabolomics and computational biology. With respect to bioinformatics, it may be advantageous to establish this expertise in a collaborative fashion with the animal genetics unit which is already developing leading capabilities in computational genetics.

- Resources for renewal

The unit has recently recruited two junior scientists and is intending to undertake senior level recruitments. These recruitments should be made to fill key gaps, i.e. bioinformatics (which has

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

already been identified by the unit) and to insure complementarily in relation to other SLU units (see synergies section below). The unit will be relocating into a new building 2011. This will represent an ideal time to maximize new staff recruitment and physically position staff to insure optimal complementation of skills and instrument needs. It will be essential to obtain optimal financial support to provide modern instruments and infra structure in order to allow effective research to proceed immediately after relocation.

- Gender balance

The unit has established an excellent gender balance and appears to have 50% of its professional staff represented by females.

- Synergies between different U of As at SLU

The intra department synergies between the unit and its “sister unit” (molecular plant biology) are excellent and involves a high level of integration. In relation to other U of As in the “genetic and breeding” field, there is evidence that contacts have been developed and in some cases collaboration has been established. In the case of the agricultural crop breeding unit at Alnarp, two formal collaborative projects have been established (i.e. Salix, potatoes). In the cases of “Forest Genetics” and “Horticultural Breeding” some contacts appear to have been made, but formal collaborations were not evident. It is recognized that there is a challenge to establishing collaborations across geographic centers; however opportunities for collaboration should be explored, particularly as new staff members are recruited. Opportunities for cooperation in bioinformatics should be developed with the active group in the animal genetics U of A.

On the basis of this evaluation, award a score from 1-6 ⁴:

6

B 3. Performance of the Unit of Assessment against the Evaluation Criteria –

Not applicable

B 4. Actions for development at the Unit of Assessment

Actions for development could include:

- Recruitment of new staff members to insure expertise in critical disciplines/technologies (bioinformatics)
- Insuring access to instrumentation and infrastructure in the new building
- Success in new major (identified) funding initiatives
- Position the unit as a strategic upstream group in a strong position to interact with other U of As in SLU, public institutions and private sector organizations
- Insuring excellence through focused activities utilizing key model and crop systems.

B 5. Additional information

The genetics and breeding research field represent a key area of investment for SLU, building on historical strength and positioning the institute in a strong position to take advantage of the rapidly emerging area of genomics and related bioscience technologies. Thus the genetics and breeding field could be viewed as an inter faculty informal, but strategic program.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

The genetics and breeding” unit (480_2) should be positioned as an “anchor group” within the overall program, providing leadership in cutting edge technologies relevant to long term crop diversification/improvement in Sweden.

As relevant U of As are spread across four faculties in four locations, a regular system of meetings might be considered to build relation (particularly as new staff are recruited).

The upcoming vacancies in key positions across the programs provide an excellent opportunity to build a world class program in basic and applied genetics.

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 631_1 Agricultural Plant Breeding Research

B 1. General assessment of the Unit of Assessment

- **The current research profile with regard to content, depth and breadth:**

The research profile of this UoA is centered on three pillars: taxonomy, conservation of genetic resources and breeding. The scope of the research programme is wide but not deep. It includes the creation of plant material (pre-breeding) adapted to the Scandinavian climate and to sustainable agriculture. The Unit also has assumed some of the activities carried out by Svalöf Weibull AB after it was closed in 2007, and especially its potato breeding programme. The target species are mostly cereals and oil crops and their wild relatives, although other species are also studied (e.g. potato, *coffee*). The targeted traits are mainly based on resistance to pathogens, but they also include other traits such as allelopathy. One specific and original programme of the unit aims at the domestication of a new perennial oil crop (*Lepidium*).

The personnel of the unit have good expertise on genetic resources and plant breeding. The presence of a taxonomist in the unit is an asset. However, the publication strategy of the unit should be improved to access better ranked journals. This could be achieved by focusing of activities, integrating advanced genomics/biosciences technology, and by switching from descriptive to hypothesis-driven research.

One major achievement of the unit is its strategy of internationalisation of research and teaching. This has brought a number of foreign students into the unit, and has allowed the development of relationships with international research organisations such as CYMMIT and ICARDA. The unit collaborates efficiently with other units in the SLU and with other universities, in Sweden and elsewhere.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- **Originality of ideas, choice of methods, scientific productivity, impact and prominence:**

Most of the research done is sound although not highly original. The exception is the domestication programme on *Lepidium*, which is novel but has not yet resulted in any publications. The methods used do not always take advantage of the new molecular tools. The scientific productivity is reasonable, but the quality of journals selected for publication could be improved with a better publication strategy. The productivity and the impact of the unit could have been better assessed by providing information on how the germplasm developed by the Unit has been used by breeders, but this information was not provided.

- **Geographical scope and quality of academic networks and collaborations:**

The unit collaborates with several laboratories worldwide that are involved in the management and characterisation of plant genetic resources (e.g. Biodiversity International, ICARDA and CYMMIT). There are collaborations with developing countries; the training provided to students will assist in the development of independent breeding programmes.

Although the unit claims to focus on breeding for adaptation to Scandinavian climate, it is unclear which traits are being targeted.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The adoption of the breeding programmes led by Svalöf-Weibull before 2007 has created potential opportunities in applied crop genetics (i.e. cereals, potatoes). The unit has emphasized the importance of PhD student training and development and has been proactive in training of foreign students. In order to build a long-term leadership position in this field, it will be necessary to recruit a scientific leader with skills in evolutionary/quantitative genetics and a solid understanding of molecular genetics/genomics. This is critical to fully realise the potential of the genetic resources collected over the years, both in terms of genetic traits selected for study and the evolutionary studies on genetic diversity.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The activities conducted by key researchers of the unit in the field of biodiversity, gene pools and use of those in breeding programmes is recognised internationally and has attracted a high number of collaborations and foreign students. The UoA has the ability to generate genetic material for private breeders and for developing countries and to train students from the developing world. The international networks that have been created have set the stage for future development.

(a) Regional/National/Nordic: the unit proposes to breed crops for the Scandinavian region and to be in a position to address impacts of climate change. It is unclear which traits are being targeted, therefore it is difficult to assess impact.

(b) Global: The activities conducted by key researchers of the unit in the field of biodiversity, gene pools and use of those in breeding programmes is recognised internationally and has attracted a high number of collaborations and foreign students.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

- **Areas of high and realisable potential in the UoA strategic plan:**

1. The establishment of taxonomy/phylogeny as a focus for SLU is strategic, but will require more input. There is a need to develop more collaborations within SLU and beyond in other fields such as evolutionary genetics and population biology.
2. Further development of the UoA as a centre for R&D on conservation of genetic resources.

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² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

However, large collections of genetic resources already exist in EU countries, and the UoA should avoid duplication of efforts. There is a need for complementation with existing collections with specialisation on specific Scandinavian cultivated species and wild relatives. The cost of the maintenance of such resources should not be underestimated, and recurrent funding must be secured.

3. The unit should be a centre of R&D for practical plant breeding including pre-breeding efforts. Although private companies have the resources to carry on efficient breeding programmes, it is essential that universities maintain in-house research capability, to provide high quality training to students and to carry out high risk or innovative breeding programmes that are not pursued by private companies. This area will need to be strongly reinforced in the very near future.

The Unit should focus on generic research with a proof of concept on one species to produce high quality papers.

- **Resources for renewal:**

It will be critical to maintain/enhance the PhD student programme and to recruit a senior researcher as previously described. Long-term support for breeding programmes will be an issue.

- **Gender balance:**

Women are included as researchers and technicians, but we noted that data in table 3 are incorrect.

- **Synergy with other SLU UoA:**

Synergy was difficult to assess since a global view of plant sciences at SLU was not provided. The model to follow should be similar to the animal genetics programme. Enhanced interaction/collaboration with the plant breeding and genetics unit at Uppsala is warranted as this group can provide access to emerging genomes technologies. The two units are already cooperating in the area of potato diseases and Salix evaluation, but additional opportunities are most likely available.

We recommend a common computational group that will collaborate with animal and plant research (forest and agronomic crops).

On the basis of this evaluation, award a score from 1-6 ⁴:

3

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

N/A

B 4. Actions for development at the Unit of Assessment

After having been somewhat neglected in the last decade, genetics has regained interest by the plant scientific community. The use of genetic variability to understand the molecular basis of phenotypic traits is an expanding field worldwide. It relies on collections of genetic resources, either natural or engineered, on high throughput sequencing, genotyping and phenotyping tools and methods. The molecular markers developed for specific traits can be used in marker

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

assisted selection and to make breeding more efficient. However, new methods of genetic analysis (e.g. whole genome association genetics) and for breeding (e.g. plant genome wide selection) need to be designed and evaluated. The mission of a public research institution must be to contribute to their development and to their evaluation using real datasets and material. The combination of expertise on population, evolutionary genetics, quantitative genetics, and skills in molecular biology is necessary to make advances in this research field. Furthermore, it is necessary to sit down with different stakeholders (e.g. private breeders, consumers, farmers and economists) to define the targets for breeding. It is also necessary to work in close connection with other research fields (agronomy, plant pathology, physiology and environmental sciences).

B 5. Additional information

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 631_2 Plant Biotechnology

B 1. General assessment of the Unit of Assessment

- **Current research profile with regard to content, depth and breadth:**

The vision of the UoA is to do research aiming at the replacement of fossil oil by vegetable oil as a feedstock for the chemical industry and to use biotechnological approaches for introducing novel crops for a more sustainable crop production.

Currently, the UoA is split into two groups with different research focus and aims, i.e. Biotechnology Agriculture (B.A.) and Biotechnology Horticulture (B.H.). B.A. has historically focussed on the biosynthesis of plant lipids (seed storage lipids) with a more recent direction of carbon partitioning between major storage compounds in sink tissue (sugar, starch, oil). Research of B.H. aims at the improvement of specific traits of horticultural plants using biotechnological approaches (tissue culture, genetic engineering). This includes important traits such as rooting ability, dwarf and early flowering fruit trees. The group can provide service for the micropropagation and genetic modification of perennial as well as annual plants.

The approaches and tools developed are to some extent generic, particularly in B.A., and are used for the improvement of complex traits in crop plants such as seed quality of oil-producing plants and productivity of fruit trees. Strong international collaborations have been established by the B.A. group, who are world-leaders in plant lipid biochemistry. In comparison, the spectrum of the B.H. group is broader and more directed to practical application in horticulture (i.e. fruit tree production) at a national level.

- **Multi-and interdisciplinary activities:**

Research of the UoA has been highly focused and successful (B.A.) in terms of the number of publications in high impact journals such as Plant Physiology. This UoA has developed a fruitful environment for research. The group has the potential to attract highly motivated and skilled researchers in the field of plant biochemistry and biotechnology.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- **Originality of ideas, choice of methods, scientific productivity, impact and prominence:**

Research groups of this UoA have been able to develop and use the latest tools in plant biochemistry, biotechnology and genetics to understand and describe the biosynthesis and formation of major plant storage compounds such as seed lipids. Furthermore, the availability of enabling techniques such as plant genetic transformation is necessary for gene functional

analysis and improvement of crop plants. The choice of problems and experimental methods has resulted in scientific success and recognition in the plant lipid community (B.A.) and in the horticultural sector (B.H.).

- **Geographical scope and quality of academic networks and collaborations: national and international (EU, USA):**

Joint research project between this UoA and global partners include the large EU project ICON guided by Prof. Stymne. The work of the fruit tree group (B.H.) seems to be more focused on the needs of fruit (apple) production in (Southern) Sweden.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

- **Ability to lead the scientific debate in its field and to provide an attractive research environment:**

The UoA have been leading in fundamental research to analyse complex plants traits, such as seed lipid biosynthesis (B.A.). Now, they are developing new approaches including model plants such as nutsedge (model for root lipid storage) and plant genetic transformation and massive parallel sequencing to domesticate and develop potential crop plants such as *Crambe* and *Lepidium* to produce novel plant oils as industrial feed-stocks (e.g. waxes). Another interesting and potentially “new” crop for sustainable agriculture may be oats with a very high oil content.

This UoA has been successful in providing a stimulating environment for successful scientific research. Sustaining the staff of the group will be important to keep this group in the forefront of its research field in the years to come.

- **Broader role in society as an independent and trusted source of opinion:**

Based on its competence and international reputation this UoA can create more trust in modern plant biology and breeding using molecular approaches including genetic transformation as well as testing and cultivating genetically modified plants.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

- **Ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry:**

The research by this group (B.A.) on plant biochemistry, lipid biosynthesis and formation of major storage compounds such as sugars, starch and oil is generic but also applicable to plant development and breeding. This work has strongly contributed to international lipid science, breeding and oil crop production. A better understanding of respective developmental processes is a prerequisite for straight-forward breeding of improved varieties and for the production of novel oil qualities for oleochemical industries. The other group (B.H.) has

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

succeeded in developing useful enabling technology (genetic transformation) for perennial (apple, *Lepidium*) and annual plants (brassicas, crambe).

The domestication of “new” plants species and the propagation (revitalisation) of “underutilized” crops is a significant contribution to sustainable agriculture. Fruit trees that are better adapted to adverse environments are the basis for economic fruit (e.g. apple) production in Northern countries like Sweden.

- **Geographical (a: regional/national; b: Nordic/European; c: global):**

(a) The UoA have developed a successful research team of national importance in plant biochemistry and genetics, providing key expertise for studying storage compound biosynthesis and yield in model and crop plants.

(b) The UoA is a desirable partner in EC research, for example Prof. Stymne is acting as the organiser of the EC project ICON (Industrial Crops producing added value Oils for Novel chemicals).

(c) Basic research of the UoA on seed development and genes underlying specific traits has a global impact in oilseed crop breeding. This is restricted in Sweden due to the very limited commercial plant breeding sector and the discontinuation of public breeding activities.

- **Temporal (a: short-term; b: medium-term; c: long-term perspective):**

Current work of the UoA has built the basis for improvement of major complex (seed) traits of oil crops, but also in other cultivated and underutilized plant species in the short and medium term. This UoA has a vision of the needs for future plant science and breeding research with an emphasis of understanding pathways and developing new germplasm.

On the basis of this evaluation, award a score from 1-6 ³:

4

4. Strategy and Potential

- **Areas of high and realisable potential in the UoA's strategic plan:**

The UoA has a clear vision of the needs for future plant science and breeding research in its field, focussing on unravelling of pathways and developing novel crop plants (crambe, *Lepidium*, high oil oats, Resistant potato) and breeding materials.

- **Resources for renewal; note whether younger faculty are being developed/recruited to support the UoA's strategic direction:**

The UoA has a comparatively small staff number, which definitely requires quantitative improvement. The strategy presented to the panel implies a better integration of the two existing groups (B.A. and B.H.) using the competence of the horticultural group in genetic engineering of different (agricultural) plant species. This is expected to strengthen the Plant Biotechnology Unit as a whole. When recruiting a new professor emphasis should be given to expertise and international reputation in the field of plant biochemistry/molecular genetics.

- **Gender balance in the UoA:**

Balance of gender among researchers in the larger group is good.

- **Synergies between different UoA's at SLU:**

The research of this UoA is of basic importance and a prerequisite for molecular and applied breeding of oil-storing plants. The existing and future results can lead to new crops species and cultivars. However, this provides the synergistic cooperation with other groups in the field of (applied) breeding (e.g. UoA 480_2, UoA 631_1, 631_4). Such collaboration should be developed and exploited.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

On the basis of this evaluation, award a score from 1-6⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Not applicable.

B 4. Actions for development at the Unit of Assessment

- **How the UoA might further strengthen its research and/or the relevance of its research**

The group has very strong international links and cooperation with the leading groups around the world. However, it could strengthen its research by establishing a platform for analysis of metabolites - leading the way in metabolomics – using knockout technologies to examine/build new lipid pathways etc. Using sophisticated searches of private EST/genome databases - for example predict pathways based on homologous/orthologous genes – as well as a systems biology approaches to model the dynamics of lipid pathways may be recommended. In order to maintain their strong international links it would be welcome to strengthen the scientific staff (number). In the longer term, the recruitment of highly qualified leading staff is critical to the future of the plant biotechnology group.

- **How the UoA might strengthen its international links to promote positive development**

The UoA intends to focus its research activities on studies of oil-bearing plants, extending the plants investigated: From model plants such as Arabidopsis and crops (e.g. brassicas) they would like to domesticate and develop “new” plants such as crambe, *Lepidium* and oats as a high-oil cereal. Based on the existing and strong international links of the group such extension of research can strengthen the international links and therefore broaden the spectrum of potential collaboration and intensify international cooperation.

B 5. Additional information

As part of the Department of Plant Breeding and Biotechnology in the Faculty of Landscape Planning, Horticulture and Agriculture Science the UoA Plant Biotechnology is located in Alnarp. Like the Department of Plant Biology and Forest Genetics at Uppsala the research of this UoA is basic for molecular and applied plant breeding approaches.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 631_4 Horticultural Plant Breeding Research

B 1. General assessment of the Unit of Assessment

The research on the Horticultural Plant Breeding Unit involves basic and applied approaches on fruit species both tree fruits and small fruits emphasizing established crops including apple, pear, and black current and underutilized crops including dogroses, sea buckthorn, and vacciniums. Pre-breeding efforts have emphasized adaptation to northern climates, disease resistance, and quality and a number of cultivars of tree fruits, small fruits, and ornamentals have been released with more in the pipeline. Genetic resources have been screened with DNA markers (passport data and genes of interest). A comprehensive genetic and cytogenetic analysis of dogrose (*Rosa* sect. *Canina*) has contributed new information related to taxonomy and evolutionary biology. Bioactive compounds related to human health have been stressed. Efforts are underway to produce new nutritious fruit products with emphasis on underexploited and new crops, and the unit has already been successful in developing a marketable new product (high-vitamin sea buckthorn juice mixture). Long term plant collections have been maintained while efforts are underway to produce new nutritious fruit products with emphasis on underexploited and new crops. Cooperative efforts are carried out with researchers in other units of SLU, other universities within Sweden and other Nordic countries, with several community enterprises including consumers, and the food industry. The unit has also developed a very successful communication and education policy targeted at the general public.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Current research quality has been of high caliber but the output has been restricted due to financial stresses. The basic problem is that applied horticultural research had been out of favor with granting organizations notwithstanding the fact that biotechnology in horticulture has not yet paid off as anticipated up to this point. In spite of this, research productivity based on publications has been strong. The increased interest in human health and wellbeing needs to be exploited in a way to obtain sustained funding efforts. The general appeal of horticultural species both for nutrition and human wellbeing needs to be utilized to forge a connection between the University and the larger Swedish community. Recently, an upsurge in cooperative efforts has led to increased funding and a brighter picture appears to be emerging.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The Unit has the talent, leadership, and inclination to defend its role as a force in horticultural science and endeavours to provide an important platform for a strong interaction with both the university and non-university community. The products of its research effort can be understood and appreciated by a wide audience including a number of stakeholders but it requires continued commitment of the University. Increased interest in germplasm within the international and Nordic community offers optimism for this unit in the future.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The increased interest in a healthy life style by the general community and the association of advances in human health by increased intake of fruits and vegetables is a positive force for this unit. The investigation of new health properties of small fruits is an opening for this unit to make significant contributions to the Western diet. Thus the study of non-allergic apple germplasm could provide an important marketing tool for the fruit industry. The unit is well positioned to make advances in this area and help the food industry create new products that could have wide acceptance.

The unique climate of Sweden -- cool climates and very long days -- can be exploited to transfer findings of this unit to other areas of similar climates such as other Nordic countries Russia, Canada, and northern China.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Future research potential of this unit will be enhanced by exploiting the medicinal and health properties of these new fruit crops. It is imperative that the future research coordinate applied and fundamental approaches. This will involve cooperation with both the food industry, currently underway, and the medical and nutrition community. Progress will require a close association with other research units as well as the incorporation of new staff to incorporate approaches in biochemistry (e.g. in metabolomics) and physiological and genetic analysis. The panel believes this is achievable by combining the strengths of current units within SLU along with cooperative programs and synergies in schools of medicine such as Lund and Uppsala. At the present time the unit has many young enthusiastic researchers with an appropriate gender balance. We suggest that Balsgård would be established as the Fruit

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

Centre for genetic collections of Sweden. A decision will have to be made if the supporting basic science need to be carried out at Alpnarp or at Balsgård but in any case these two programs need to be integrated.

On the basis of this evaluation, award a score from 1-6⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The unit does not have a present role in environmental monitoring and assessment.

B 4. Actions for development at the Unit of Assessment

Horticulture is fragmented at SLU. Horticulture has wide appeal to the local community as well as national and international impact based on health aspects of its products, the contribution of amenity gardens and landscapes to human wellbeing, and the high economic impact of the green industry. Thus, consolidated efforts of the units of the University related to horticulture need to be attempted to present a united front to obtain resources and create a greater impact and awareness. This will require increased cooperation and coordination with Alnarp, as well the Landscape Architecture program.

B 5. Additional information

The University needs to have a balanced research effort that discounts short term trends and stresses only fashionable areas of research. Research, especially at an agricultural university needs to take a long-term view of what is appropriate. For example, long term plant collections need to be nurtured; once destroyed they can be replaced only with difficulty, if at all. The future is hard to predict but it is clear that human resources and continuity represent one of the strengths of the university.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 14. Genetics and Breeding

Unit of Assessment: 670_1 Molecular genetics and bioinformatics

B 1. General assessment of the Unit of Assessment

- **Current research profile with regard to content, depth and breadth:**

The overall aim of the UoA is to understand the genetic basis for phenotypic variation, in particular in domesticated and companion animals. The approaches and tools being developed are generic and, in some cases, are being used in the analysis of traits in plants. Multi and inter disciplinary approaches are being used to analyse simple and complex traits in domesticated animals. A wide range of species are under study, including companion (dogs and horses) and commercial (chicken and pigs) animals. Comparative genetics is widely used to compare and exchange information between these and other species, in particular human. These comparative approaches have been productive in developing human models of genetic disease. Very successful strategic collaborations have been made, in particular with veterinary medicine and Kerstin Lindblad-Toh at Uppsala University through the CFG. These provide access to world class expertise in comparative genomics and access to materials and information on horse and dog resources.

- **Multi-and interdisciplinary activities**

For each problem, multiple skills and approaches are being used, including genetics, genomics, bioinformatics, statistics, computer science and more recently detailed studies on specific transcription factors (IGF2-TF) have used proteomics, RNA and mouse knockout technologies.

This UoA has been very successful, and have developed an exciting environment in which to do research. This group has the potential to attract highly motivated and skilled researchers. It also has the potential to benefit a wider group in SLU, such as animal and plant and forest genetics, dependent on the use of novel genetic and genomic technologies.

The UoA has been very successful in terms of the number of publications in high impact journals such as Nature Genetics.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

- **Originality of ideas, choice of methods, scientific productivity, impact and prominence:**

This UoA has always been willing to develop and use the latest tools in genetics and genomics to understand the nature of phenotypic variation in domesticated and companion animals. Careful choice of experimental problems has often resulted in success and recognition. The choice of simple Mendelian traits in dogs and horses, are examples of this successful approach. The work on dogs has also benefited from novel ideas for low and high

resolution genetic mapping taking advantage of the population structures of dog breeds. This UoA is set to capitalize on new, ultra high throughput DNA sequencing and genotyping technologies to identify the nature of domestication in chickens and the identification of causal mutations controlling production traits in broilers and layers.

- **Geographical scope and quality of academic networks and collaborations: national and international (EU, USA):**

Alliances between this UoA and the veterinary clinicians at SLU, scientists at CFG (Uppsala University-SLU) and the Karolinska Institute are a national asset. This UoA also collaborates widely with international groups, in particular in Belgium and USA. Members of the UoA are also well represented in EC programs and international meetings (e.g. ISAG, CSH, PAG).

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

- **Ability to lead the scientific debate in its field and to provide an attractive research environment:**

This UoA have been instrumental in developing fundamental approaches in the analysis of complex traits. They are now developing new tools and approaches to handle new data sources such as the integration of data from high throughput technologies (sequencing, gene expression, etc). This UoA succeeds in providing a stimulating environment of scientific research, in particular by fostering a mixed skilled set for example in genetics, genomics and computer science. The ability to develop new genetic, statistical and computational solutions is a key asset, which will keep this group in the forefront of their research field for years to come.

The scientific excellence of this UoA has also been recognised by two national foundations (SSF and Formas) in competition with other research groups in the life sciences with awards to create the Centre for Functional Genomics in Uppsala. The achievements of younger scientists within this group has also been recognised for example, with the EURY1 (11 MSEK) ESF award to Dr Carlborg for 5 years.

- **Broader role in society as an independent and trusted source of opinion**

This UoA fosters links with stakeholders effectively. For example, talks and meetings with vets and dog owners have been important in gaining access to samples and information on dog breeds. It also increases the trust and reputation of this group both nationally and internationally. Dissemination of results is also facilitated by hosting a number of www sites of interest to dog geneticists and breeders, molecular biologists and bioinformaticians.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

- **Ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry:**

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

The research on the genetic basis of phenotypic variation is generic; applicable to animal and plant systems. The identification of causal mutations for specific dog and horse mutants as the potential to help both veterinary clinical medicine and to serve as models of human disease. The work on the genetics of meat production in pigs and the identification of causal mutations has contributed to international pig production. Access to Swedish animal breeding industry is limited, but the provision of knowledge and protection of IP by Patents are ways this group makes a direct contribution to this industry. However further efforts should be made to interact with Swedish industry, for example, by providing access to tools and resources.

- **Geographical (a: regional/national; b: Nordic/European; c: global):**

(a) UoA has developed an important research team of national importance in dog and human genetics, providing key expertise for the study of genetic diseases in these companion animals.

(b) UoA members are key partners in EC research, for example they play a major role in the LUPUS dog genetic project.

(c) UoA basic research on the development of new genetic tools and studies of causal mutations underlying specific traits has a global impact in animal breeding. This is limited in Sweden due to a limited animal breeding sector.

- **Temporal (a: short-term; b: medium-term; c: long-term perspective):**

The current work has set the scene for the study of complex traits in a wide range of species in the short and medium term. This UoA have a vision of the needs for genome research that stretched into the future at least for the next 10 years.

On the basis of this evaluation, award a score from 1-6³:

6

4. Strategy and Potential

- **Areas of high and realisable potential in the UoA's strategic plan:**

The study of complex traits in dogs and horses has great potential in both veterinary clinical medicine and comparative medicine as models of human disease. The proof of principal has ended with the identification of the basis of simple Mendelian traits in dogs (ridges) and horses (greys). The next stage will be to extend this system to the analysis of complex traits such as autoimmunity (e.g. current work on SLE has identified 6 critical loci), heart disease and skeletal problems, common in specific breeds of dogs. Sequencing of chicken and other genomes is now possible, and this UoA has started on a pilot study of multiple chicken strains. The analysis of these data has defined putative regions and genes that may have had a role in domestication and commercial traits.

- **Resources for renewal; note whether younger faculty are being developed/recruited to support the UoA's strategic direction:**

In the next 5 years applications in bioinformatics will be critical to fully realise the potential from new data rich sources, such as sequencing and genetic variation projects. The planned recruitment of bioinformatics post will support this strategic aim.

- **Gender balance in the UoA:**

Reasonable balance of young researchers.

- **Synergies between different UoA's at SLU:**

Key alliances within veterinary medicine (UoA 715_7 small animal medicine with practicing clinical veterinarians) provide critical access to insurance records and materials for the analysis of dogs genetic traits. This has been instrumental in raising this UoA profile for

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

example as a key partner in the FP7 EC LUPA project. This UoA provides advice and generic tools of use in plant and tree genetics, as well as synergies with quantitative genetics and animal breeding (UoA 670_2).

On the basis of this evaluation, award a score from 1-6⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

Not applicable.

B 4. Actions for development at the Unit of Assessment

- **How the UoA might further strengthen its research and/or the relevance of its research**

Recruitment of high calibre staff is critical to the future of this group, if it is to keep at the cutting edge of developments in the field. Alliances between SLU and Uppsala University and the recruitment of staff with skills from outside the traditional field of genetics, for example from computer science and physics, is one way this UoA maintains an exciting environment to do research. The recruitment of a group leader in bioinformatics able to develop databases to handle diverse data sets (sequences, gene expression, protein-protein interactions, Chip, etc) will be essential to fully realise the potential of the current programmes. Continued external links outside SLU, such as Uppsala University and Karolinska Institute are key alliances and should be maintained. Access to animal facilities to study gene interactions in chicken complex traits is desired. Strategic decisions need to be made either to gain access to these facilities for specific needs (for example with local facility or alliance with a lab elsewhere) or to fully commit to the creation of a poultry facility, with animal technicians etc for the long term.

- **How the UoA might strengthen its international links to promote positive development**

Development of open sources to exchange bioinformatics tools and information within specialised databases will spread the influence of this UoA in international science of the genetics of phenotypic variation. Access to the genome sequences of lines of chicken and dog breeds will increase the number of collaborations and funding sources for this group.

B 5. Additional information

In this age of genome sequencing and applications of high throughput technologies, there is an urgent need for access to sophisticated tools and resources in bioinformatics and computational biology. The close interactions between computational biologists and the geneticists in the animal genetics group is a good example to all. Many of these approaches are generic in principal, however are not always accessible to everyone. Ways should be found to create a similar core computational group within plant genetics.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Report Template – Part A

Panel 15. Chemistry, Molecular Biology and Microbiology

A. General Assessment of the Research Field at SLU

The research field “Chemistry, Molecular Biology and Microbiology” is strong. All UoA within this field have a scientific quality that is above the average of the SLU. This is evident from the bibliometric analysis which shows most or even all of the indicators as being above average. About 10% of the publications reach a level that scores among the top 5%. Inspection of the publication lists shows that there are many publications (about 800 for the whole research field) and frequently in the top journals of the particular disciplines. The average quality of the output is internationally recognized or even of high international standard (score 4-5).

The researchers of the different UoA are generally well recognized and received a number of awards and filled important positions on scientific and societal panels, despite the fact that some leaders did not like to brag with achievements. They considered it the logic drive for scientists (3-4).

The relevance of the research for society in Organic Chemistry and Microbiology is of utmost or very high importance (5-6), There are a large number of patents and commercial spin-offs, or newly generated knowledge is of high demand from industry. However, the relatively young group of Solid State Inorganic Chemistry also starts delivering products useful for pharmaceutical industry (4).

The different units within the research field are usually well equipped and have a critical mass of funding and staff, to have a very good to excellent potential (4-5) for the future.

However, it appears odd that the Chemistry disciplines are represented by 3 different UoA, while Microbiology is represented by just one large UoA. Combination into a large unit creates more impact and resilience and thus, is preferred. Chemistry is a fundamental science which is of particular importance for the other disciplines in the research field, Microbiology in particular. Therefore, it is plausible to keep the Chemistry as a unit together. Structurally the Department of Chemistry now hosts three independent groups: Organic Chemistry: Natural Product Chemistry (450_1), Inorganic and Physical Chemistry: Molecular Soil Biogeochemistry (450_2) and Solid State Inorganic Chemistry: Environmental Materials Chemistry and Bionanotechnology (450_3). The latter names reflect the suggested field of competence. However, all subgroups are very small with only one professor in charge of all heavy teaching duties and research activities. It should be particularly stressed that the Chemistry Chairs should not be dispersed into the applied Bio-Departments, thereby losing a high-quality impact on teaching and research.

It is useful to locate Microbiology, Forest, Food and Plant sciences together into the Uppsala BioCenter. This collocation will promote enhanced collaboration. The contribution of Chemistry to the BioCenter and further to the SLU can be secured by keeping the chemical UoA together and further strengthening them by addition of a research group on Synthetic Organic Chemistry and possible also a research group on Biochemistry. The Molecular Biology presently attempts to serve as a “virtual” unit in the BioCenter. This will be of benefit to the BioCenter, provided a strong and active participation is guaranteed.

Care should be taken that core competences of the individual groups are preserved and strengthened, since competence is the crucial basis for collaboration and creation of added value. Education of young researchers in structured curricula would guarantee that qualified PhD candidates are available for research and would make the BioCenter attractive for young talents from outside Uppsala.

Part B: Report on individual Unit of Assessment

Panel 15. Chemistry, Molecular Biology and Microbiology

Unit of Assessment: 420_1 Molecular Biology

B 1. General assessment of the Unit of Assessment

Overall the Molecular Biology UoA is very strong with an excellent research profile. Their high-quality research programs include studying several diverse basic fundamental problems in biology. These include structurally investigating enzymes involved in CO₂ fixation, carbohydrate uptake and metabolism, membrane transport, protein folding and engineering, and designing drugs for enzymes implicated in tuberculosis and malaria. The group has a close and synergistic relationship with the Uppsala University (UU) structural biology group at the BMC, which lead the UoA to be more focused in the structural biology discipline. The integration with the UU group has contributed to the strength of the UoA. However, it has also resulted in isolation of this UoA from the main SLU campus. Yet the association with the UU group has created a critical mass in structural biology which has both economic and scientific benefits, which may be lost if the groups were to separate. For SLU to fully benefit from the high research potential of this UoA, the panel feels the group needs to be more proactive in initiating links with the new BioCenter on the SLU campus, which will provide opportunities for more interdisciplinary methods and approaches in investigating biological problems.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

Historically, the UoA was a world leader in structural biology, but the loss of key members has reduced the impact in recent years. Yet the group has a strong record with 187 publications in the last 10 years, many of which are in the top rated journals such as Nature, Nature Structural Biology, Cell, J. Mol. Biol., and Proc. Nat. Acad. Sci. USA. The group is fully integrated with the UU structural biology group resulting in a high quality academic network. This UoA has contributed significantly to this research community that has attracted 7 current PhD students and 11 published dissertations in the last 5 years (Bibliometric Analysis Report only reports two Theses). Another indicator of scientific quality, productivity, and impact has been the ability of UoA to successfully obtain competitive grants (the top 5 grants total 10,7 MSEK). The UoA has number of national and international scientific collaborations include EU networks, Linnaeus Centre, SSF Centre of excellence and locally on MicroDrive.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The close relationship between this UoA and UU structural biology group has overshadowed the UoA's independent identity slightly impacting the recognition and leadership. In spite of this they still have a good profile and are internationally recognized. UoA members have been invited to give 21 international and 15 national seminars over the last five years. Additionally, with the Structural Group at UU, they have organized EMBO Protein Crystallography workshops.

Members Andersson and Härd actively serve on the Swedish Research Council (Härd is chairman of the Biochemistry and Biophysics committee). Two members (Mowbray and Härd) are part of the "Faculty of 1000 Biology".

A number of awards have been given to members of this UoA. Emeritus professor Eklund received the prestigious Aminoff prize in 2008. Professor Härd was elected the Royal Academy of Sciences (Kungl. Vetenskapsakademien). Additional awards received by UoA members include: SLU teaching award, award for best thesis by Royal Swedish Academy, Karl Johan Öbrink Prize.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research in this UoA is mainly curiosity-driven providing a fundamental knowledge, which will contribute to society in the long term. This UoA has well-established links with industry such as AstraZeneca and Medivir, leading to potential development of new drugs against tuberculosis and malaria. The potential for further commercial exploitation of scientific discoveries within this UoA will be enhanced further with the new professorial appointment. To date, two patents have been awarded and five are currently submitted. Additionally approximately half of UoA PhD students contribute to society by establishing careers within industrial and pharmaceutical companies.

The UoA's basic research findings have lead to new fundamental knowledge which has been incorporated into basic and advanced textbooks. They are keenly involved in outreach activities which include providing scientific information for news articles in Kemivärlden Biotech, giving Popular Science Seminar, Karl Johan Öbrink Lecture, and hosting an open-house to potential future PhD students.

Members serve as consultants for industry in national and European industries including AstraZeneca and Medivir in new drug design against tuberculosis and malaria, and Genencore/Danisco for Biofuel production. These collaborations are likely to contribute to and impact society more in the medium to long-term time frame.

On the basis of this evaluation, award a score from 1-6 ³:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

4. Strategy and Potential

Currently the UoA lacks strong leadership and direction, but clearly has the potential to regain its world-leading status dependent on the development of a clear strategy for the future. The recent hiring of Torleif Härd (a member of the Royal Academy) not only brings a new discipline to the UoA (NMR) but significantly strengthens this department and offers a chance to gain leadership and world-impact potential.

The panel feels that the department's strategy should include a more active role of the UoA to establish links within the new BioCenter to strengthen and expand the research base of both SLU and the Molecular Biology UoA. This is likely to require additional resources from SLU both in personnel and finances.

Clearly this UoA has potential, as the science held in high regard as evident by the significant publications and strong funding until 2011 and possibly extending to 2015. Additionally, appointment of both a senior and junior professor expands two new disciplines to the UoA further enhancing their potential.

On the basis of this evaluation, award a score from 1-6 ⁴:

4

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

N/A

B 4. Actions for development at the Unit of Assessment

The UoA has a very strong curiosity-driven program, but can be strengthened with a more ambitious plan in the needs-driven research area while maintaining the strong basic research for long-term society contributions. To realize the full potential of this UoA, stronger support from SLU in form of resources will be essential.

B 5. Additional information

The panel found reported bibliometric analysis to be incorrect. The reported h-index indicators appeared too low, which upon brief examination by the panel on the Web of Science, found the publication indicators equal or greater than other UoA within the panel (not indicated in the reported Biobibliometric analysis). Another example of Biobibliometric errors includes the listed dissertations for the Molecular Biology UoA. The Bibliometric analysis stated 2 Dissertations published from 2004-08, but UoA submitted list of 11 dissertations published during this time.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 15. Chemistry, Molecular Biology and Microbiology

Unit of Assessment: 450_1 Organic Chemistry, Natural Product Chemistry

B 1. General assessment of the Unit of Assessment

The research at the UoA is focused on identification and characterization of the molecular machinery of cells and the molecular interplay between organisms. The development of separation methods and the detailed chemical identification and analysis is based on a strong chemistry based approach and the chemical methodologies and chemical techniques are applied to the solution of relevant biological problems.

The themes in the group are oligosaccharide chemistry, metabolite discovery and molecular interaction analysis.

The research group is well known both by academic and industrial partners both in Sweden and abroad. They have a strong but internally understated network of key collaborators who come to the lab for longer or shorter periods to adopt the chemical methodologies developed at the group.

The research group is well equipped and has managed to obtain heavy instrument through grants from Swedish grant agencies. The instruments are kept updated and are continuously adopted to handle chemical characterization of relevant biomolecules.

The group also has been instrumental in the co-funding and acquisition of the Bioimaging TOF-SIMS in Gothenburg allowing 3D imaging of molecules in single cells and in cell-cell connection interfaces. This is also a good illustration of the groups way of working together with other entities.

The group has suffered in the past due to re-localisations but is now looking forward to establish and further develop a strong chemistry identity in the planned BioCenter at SLU.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The research group of Lennart Kenne is internationally recognized for its original and innovative work, particularly with respect to the development of novel methods. They use a range of spectroscopic techniques to study some of the fundamental processes of life: the identification and characterization of the molecular machinery of cells and the molecular interplay between organisms.

A recent and outstanding example is the development of methods that allow direct measurements on the molecular systems of whole organisms, which range from structure

determination of individual molecular species to global analysis of the distribution of molecules inside or outside an organism. Another example is the use of STD-NMR (Saturation Transfer Difference) top mapping of ligand interactions at the atomic level. These methods have the potential to open up whole new areas of research.

A range of successful international collaborations, with both well know academic groups and major companies, bear witness to the impact of their research. A major reason for the success of this relatively small team is indeed the strong national and international network they can rely on to form collaborations to drive and pilot the methods they are developing, A good example is the work the group did around high resolution magical angle spinning NMR spectroscopy.

The team publishes in well-recognized journals and has delivered a steady output of high quality PhDs as well as papers. The productivity and impact is clearly beyond what you would expect from a team this size.

On the basis of this evaluation, award a score from 1-6 ¹:

2. Recognition and Leadership

The research group is recognised as good and has during the period introduced novel methodologies that have the potential to open up new research fields and expand the possibility to analyse new biomolecules isolated and in relevant situations. In particular the group has managed to integrate separation technologies with multidimensional Mass and advanced multivariate analysis to allow precise descriptions of molecular interactions as well as using the TOF-SIMS to determine the precise distribution of suspected pathogens. The group also has a strong record in carbohydrate chemistry and the understanding of solution behaviour of sugars using sophisticated purpose developed NMR methodology. Partially based on this expertise the group has been identified and included in a FP7 programme consortium PolyModE.

Within the university the group has suffered from the relocalisations generating an uncertainty and hence had a lower recruitment of graduate students and this has hampered the production of PhD's. It is encouraging to see that the hiring of new graduate students is now starting and the scientific output has the potential to be restored.

The group, students and equipment are now localised in one place and this should allow the group to further develop the research environment. The group has a leading position in its field but needs to grow in order to realise its full potential.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The group's research activities are considered to be of very high importance for sustainable development in industry as well as within the academic realm. The research group is in some aspects a gold standard in key areas, and many industries especially within the biotechnology

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

industry are adopting and applying the chemical characterisation techniques and methodologies developed at this lab. The method development and the chemical approach has also enabled analytical as well as detailed interaction data driving developments in the food and forestry sector.

The attitude of the group is very open and generous and this makes this group very easy to interact while they still maintain a very strong focus on basic research. The long list of visiting scientists, which unfortunately do not show up in the metrics on funding, is a strong validating factor for the central importance of the strong method development performed by this group.

The group also has had a greater influence on the construction of NMR hardware than they give themselves credit for.

The PhD programme is well structured and the students have a chance to influence their own projects.

The collaborations are primarily within the Nordic and European area.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The outlined strategy is to create a strong research organization with skilled scientists that develops high quality methods that enables new and advanced ways to study the chemistry of biological processes which fits perfectly into the current era of post-genomic research and has the potential to become one of the corner stones of the new Uppsala BioCenter at SLU. The scientific work that the group is aiming for is best described as system biology through the use of a combination of metabolomics, bioinformatics and proteomics.

To succeed with this ambitious strategy, that involves a wide range of advanced and rapidly developing technologies, the group needs to expand significantly. Furthermore they need to be fully integrated into a strong chemistry department that also includes a full synthetic capability (see additional information)

The retirement of Lennart Kenne will prompt for a careful and decisive succession planning. Without the renewal of the faculty professorship it will be a challenge to recruit and maintain sufficient talent to realize the strategy as it is outlined today. Without the right level of scientific leadership the methods development could stop and the group would quickly be reduced to a service function at the BioCenter. Another prerequisite is further modernization of the instrumentation.

SLU carries a special responsibility in that the team is more or less unique to Sweden and one could argue the same situation for Europe.

The group has the ambition to further increase the number of collaborations within SLU and

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

other Swedish universities as well as to strengthen the international collaborations including EU projects, which because of the heavy administrative burden is almost beyond scope for a team of this size.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – Environmental monitoring and assessment (FOMA)

N/A

B 4. Actions for development at the Unit of Assessment

The research group is of excellent scientific quality is working on relevant subjects and is well connected to its stakeholders, but it is too small to be sustainable in the long term. The group needs to be supported by a synthesis group and a stronger connect to the other chemistry groups assessed. A clear and strong decision needs to be taken as to the future of the professorial chair and the succession.

B 5. Additional information

Define a strategy plan for the Chemistry area.

The evaluation group has strong concerns about the current trend within the university, which seems to be to disperse the chemistry into the larger biology departments. It will inevitably lead to a loss of identity and competence as well as fewer opportunities for cross department learning and less optimal use of resources.

Any university with high ambitions in life sciences needs a strong chemistry presence particularly in the areas represented by this team. The remaining rather small chemistry department and its three teams carries a very heavy teaching load which has a direct impact on the amount of research they are able to do and support.

The chemistry subject needs to come together in one way or another to be competitive and maintain quality. There must be a scientifically underpinned chemistry approach available within the university in order to support the life science areas in a way that guarantees quality and secures a strong scientific development.

One way by which it can be achieved is to have the courage to integrate the dispersed chemistry departments now localized across the faculties to form a more complete and identifiable SLU chemistry infrastructure. If the chemistry departments in the different faculties could be co-localized the grading for strategy and potential would increase from 4 to 5. If the biochemistry departments across the faculties also could be co-localized with the rest of chemistry in the SLU BioCenter the strategy and potential grading could be even higher.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

Part B: Report on individual Unit of Assessment

Panel 15. Chemistry, Molecular Biology and Microbiology

Unit of Assessment: 450_2 Inorganic and physical Chemistry

B 1. General assessment of the Unit of Assessment

The UoA, Inorganic and Physical Chemistry is highly competent in characterization of inorganic solution species using X-ray spectroscopic methods such as EXAFS and XANES, which is particularly relevant for their research in water treatment. Professor Ingmar Persson has established an internationally well recognised reputation in the use of XANES (Sulfur), MALDI-ToF mass spectrometry (decomposition of PEG) and ¹H-NMR (acid analysis). The funding of these instruments has been obtained through competitive grants from Swedish Grant Agency. The research is supported by advanced scattering techniques involving synchrotron radiation (MAX IV Laboratory) which is a strategic international collaboration area for Sweden. The future seems promising due to the new recruitment of a young successful soil scientist, Dr. Anke Herrmann, who broadens both the fundamental and the applied fields of research. During her research collaboration abroad she has already specialized in cutting edge technologies, such as nano-scale SIMS and has developed a method for investigating biophysical interfaces in situ pertinent to microbial communities. Due to the small size of UoA the involvement in organisation activities and the output of PhD degrees has been modest and should be vitalized. The core competence field has been identified as, Molecular Soil Biogeochemistry.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The bibliometric analysis, in particular the NCSf, scaled hf-index/PhD, PP/PhD and Top5% scores proves that the research activity is particularly high in comparison with larger groups. Taken per professor and senior researchers they have produced most publications in well recognized Journals within the Group 15 range! In addition they have acquired highly specialized instrumentation from competitive grants. In particular they are heavily involved in the National research strategy for developing synchrotron sources in the European MAX IV facility. The advanced instrumentation described above, including expertise will be available for all groups at the BioCenter. There is a rather extensive well documented and successful international collaboration. However, the group has been remained small with a modest PhD output.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The participation in organisational activities has, according to the (incomplete?) self-evaluation report been rather modest. However, there is some high-rank participation in science oriented duties. In particular Ingmar Persson is a Chairman at the Association for Synchrotron Radiation Users at the European MAX laboratory and is also chairing the International Conferences of Solution Chemistry. The newly recruited Anke Herrman holds a chair of the Science Award Committee of the Soil Science Society of America. However, the overall engagement clearly suffers from the small size of the research groups.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The research subjects are basic and therefore the immediate applicability of the competence is limited. However, as evidenced by their contribution to the identification of the decomposition mechanism of the Vasa war ship the research of Ingmar Persson has proven important. His competence in water treatment and purification using natural substances has developed into a growing involvement with developing countries, which has also been academically productive in terms of publications. The competence of Anke Herrmann adds considerable strength to the research which is particularly relevant for SLU and its BioCenter.

Although the collaboration and production is international, the major impact is National or Nordic. However, the involvement in societies and with developing countries enlarges the international impact considerably.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

Due to their synergistic research Anke Herrmann has chosen to join Ingmar Persson at the UoA. His research of water-logged archaeological wood and decomposition compounds formed with time may find widespread use e.g. in forestry. The association of water protection and soil science research widens the scientific scope and makes the involvement in more applied systems quite natural. Adding the developed skills in water treatment using natural materials in (potentially toxic) ion speciation and in high resolution characterization gives great expectations for the future. When realized the scores given will certainly improve!

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
*Environmental monitoring and assessment (FOMA)***

N/A

B 4. Actions for development at the Unit of Assessment

As indicated in the next section the UoA should be united to a Core Chemistry and Instrument Facility (CCIF) at the BioCenter being able to provide synthetic and advanced characterization services based on own research. The funding of all Chemistry UoA should be systematically enhanced under a strong leadership and the strategy should be considerably developed by SLU in order to maximise this benefit and international credibility! The UoA research of water-logged wood as well as engagement in soil science related to water purification should certainly be strongly supported!

B 5. Additional information

Chemistry is a fundamental science which is of particular importance for Molecular Biology and Microbiology. This has been realised by SLU when bringing Microbiology, Forest, Food and Plant sciences together in the Uppsala BioCenter in a near future in order to promote enhanced collaboration.

Structurally the Department of Chemistry hosts three independent groups: Organic Chemistry: Natural Product Chemistry (450_1), Inorganic and Physical Chemistry: Molecular Soil Biogeochemistry (450_2) and Solid State Inorganic Chemistry: Environmental Materials Chemistry and Bionanotechnology (450_3). The latter names reflect the suggested field of competence. However, all subgroups are very small with only one professor in charge of all heavy teaching duties and research activities. Overall the contribution of Chemistry to the BioCenter and further to the SLU can be secured only by strengthening the diversity by adding a research specializing in synthetic Organic Chemistry to the Chemistry Department. Moreover, a research group in Biochemistry at the Chemistry and Instrument Core Facility would benefit the interaction with the Bio-research at BioCenter. It should be particularly stressed that the Chemistry Chairs should not be dispersed into the applied Bio-Departments, thereby losing a high-quality impact on teaching and research!

Part B: Report on individual Unit of Assessment

Panel 15. Chemistry, Molecular Biology and Microbiology

Unit of Assessment: 450_3 Solid State Inorganic Chemistry

B 1. General assessment of the Unit of Assessment

The UoA, Solid State Inorganic Chemistry was broken out from the Inorganic and Physical Chemistry group only in 2003 and therefore some of the reporting is not representative. Moreover they have acquired rather advanced specialized equipment from competitive grant sources. Such techniques are SEM-EDS for solid particles, SC-XRD for heavy metals in solution and P-XRD for mineral components in soil. The most important input of the research group is the introduction of sol-gel synthesis of nano-structured materials. Internationally, this competence has found use in e.g. pharmacy (drug delivery), surgery (bone materials) and in bioassay applications. Their competence in characterization of airborne fine particles leading to lung related problems has already resulted in FOMA activities.

The involvement with the Bio-research groups has, despite the extraordinary teaching load of the professor already resulted in a fruitful collaboration as evidenced by the rich number of joint publications, patents as well as spin-off SME:s. Due to the small size the output of PhD students has been modest and should be vitalized. The research in nano-structured materials certainly holds promise for the future, but the plans need to be improved within their core competence field, Environmental Materials Chemistry and Biotechnology.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

From the bibliometric analysis one can learn that, despite their young age (< 6 years) the UoA has rapidly established a strong position with a rich number of publications in particularly high ranked Journals.. Taken per professor and senior researchers they have, despite the exceptionally high teaching load produced the second most publications in very highly ranked Journals within the group 15 range! In addition they have acquired highly specialized instrumentation suitable for characterization of solid substances from highly competitive grant sources, which will be available, including expertise for all groups at the BioCenter. However, the group has been remained small with a modest PhD output.

On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

The participation in organisational activities has, according to the (incomplete?) self-evaluation report been rather modest, but is clearly growing. Moreover, there is already a significant participation in science oriented duties. Clearly the performance suffers from the small size and young age (UoA 2003). The subdivision of Chemistry into small research groups does not allow for time set aside for a strategic development of industrial collaboration network.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA provides a great variety of nanostructured materials and specialized instrumentation and skills, which have proven of great interest for the Bio-community and should find even more applications in Medicinal Technology. There is a documented substantial contribution to the interaction between academia and industry. Already the collaboration as lead to 4 patents and one spin-off SME. Additionally, the quite extensive research instrumentation identified above provides support for characterization of biological systems and in particular for environmental monitoring. In the latter case they are actively working on development of technical solutions in the analysis and evaluation of air quality in relation to particle impurities, including a prototype database for identification of particulate hazards.

Initially the major impact has been National. However, the visible involvement with sol-gel society activities holds promise for an international impact. The contacts with the enormous know-how pool and extremely important developing market in Russia are active and improving.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy has been based on developing the synthesis skills and to formulate a strategy to support enhanced collaborations and applications. The potential for nanostructured materials in Bio-sciences and Medicine is great! Furthermore the UoA has acquired basic and advanced instrumentation to support the BioCenter research and synthesis of nano-structured materials. However, due to the short independence (from 2003) a clear strategy and sharing of responsibilities needs to be formulated. Adding the developed skills and equipment in high resolution characterization gives great expectations for the future. When realized the scores will certainly improve!

On the basis of this evaluation, award a score from 1-6 ⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

The UoA has already a well formulated plan and applications for monitoring of fine airborne particles (solid aerosols), which has gained enhanced attention due to lung based diseases. This holds particularly true for the increased use of nano-sized particles in science and technology! They are actively working on development of technical solutions in the analysis and evaluation of air quality in relation to particle impurities, including a prototype database for identification of particulate hazards.

B 4. Actions for development at the Unit of Assessment

As indicated in the next section the UoA should be united to a enlarged Core Chemistry and Instrument Facility (CCIF) at the BioCenter, being able to provide synthetic and advanced characterization services based on own research. All the Chemistry UoA should be systematically improved under a strong leadership and overall strategy should be developed by SLU in order to maximise this benefit and international credibility! The UoA is rather young and suffers from long term strategic planning and sharing of responsibilities, but since the synthesis of nano-structural materials is a key field for Bio- and Medicinal-research the group should certainly be supported within Department of Chemistry. In order to improve the potential of the Chemistry and Instrument Core Facility within the BioCenter, there is an obvious need for surface sensitive instrument, such as ESCA/XPS, ToF-SIMS, High Resolution Transmission Electron Microscopy and Atomic Force Microscopy (AFM).

B 5. Additional information

Chemistry is a fundamental science which is of particular importance for Molecular Biology and Microbiology. This has been realised by SLU when bringing Microbiology, Forest, Food and Plant sciences together in the Uppsala BioCenter in a near future in order to promote enhanced collaboration.

Structurally the Department of Chemistry hosts three independent groups: Organic Chemistry: Natural Product Chemistry (450_1), Inorganic and Physical Chemistry: Molecular Soil Biogeochemistry (450_2) and Solid State Inorganic Chemistry: Environmental Materials Chemistry and Bionanotechnology (450_3). The latter names reflect the suggested field of competence. However, all subgroups are very small with only one professor in charge of all heavy teaching duties and research activities. Overall the contribution of Chemistry to the BioCenter and further to the SLU can be secured only by strengthening the diversity by adding a research specializing in synthetic Organic Chemistry to the Chemistry Department. Moreover, a research group in Biochemistry would benefit the interaction with the Bio-research at BioCenter. It should be particularly stressed that the Chemistry Chairs should not be dispersed into the applied Bio-Departments, thereby loosing a high-quality impact on teaching and research!

Part B: Report on individual Unit of Assessment

Panel 15. Chemistry, Molecular Biology and Microbiology

Unit of Assessment: 460_1 Microbiology

B 1. General assessment of the Unit of Assessment

The present research of the Microbiology group reflects the broadness of Microbiology. The UoA mainly uses its strength in Microbial Ecology and Technical Microbiology to study the role of microorganisms in different biotechnological applications. The UoA has about 65 employees (20 PhD students), which allows them to cover rather diverse research areas, which include the microbiology of food and feed, stabilization and control of microbes, intestinal microbiology, bioenergy production and mineral and nutrient cycling in soil and water. The UoA has succeeded to receive some large grants (including DOM, MicroDrivE). With these funds the group has expanded in size and infrastructure.

The UoA mentions its strengths and weaknesses. The UoA has sufficient critical mass, expertise and infrastructure to tackle the opportunities that are listed. These include subjects which are very relevant for human health and welfare. It can be expected that food and health and sustainability issues will remain important for the coming years and thus will provide funding opportunities to maintain the existing group size. Care should be taken not to dilute the expertise too much and to start collaboration were necessary. Not all expertise (e.g. systems biology, bioinformatics) is sufficiently present in house. The UoA is already collaborating with chemistry groups. This gives added value.

In the self assessment the existing competence is presented in a rather fragmentary way. In a group of that size, the personal expertise of each of the staff members should be clearly visible. The future of the chair held by Prof. Janet Jansson is of vital importance. This position should be filled in with expertise that strengthens future research. For this a clear picture of competences of individual PI's is essential. Besides defining strategic focus areas, definition of subdisciplines in microbiology that are needed to tackle future research questions is essential. International developments in Molecular Microbiology may be guidelining.

B 2. Performance of the Unit of Assessment against the Evaluation Criteria - *Research*

1. Scientific Quality

The existing expertise of the individual research members led to major scientific achievements over the last 5 years. These achievements include: the genomic analysis of a probiotic lactic acid bacterium, molecular identification of antigenic proteins, characterization of novel microorganisms with biotechnological potential (an antimicrobial yeast, a novel ethanol-producing yeast and novel anaerobic bacteria), molecular analysis of microbial communities in the GI-tract and other environments, encapsulation of bacteria and interaction of bacteria with particles, biomaterials and pesticides. The ideas maybe are not completely original, but some of

the discoveries were only made by the combined experimental and intellectual skills. The clearly build on existing expertise.

The UoA has selected a number of subjects of study that are environmentally and biotechnologically relevant. The UoA combines molecular microbial ecology with technical microbiology in many of their studies. This is supplemented by input from other groups inside and outside the university. The research is curiosity driven and many studies are into depth. Looking to the subjects of study, some projects are at a molecular level others at ecosystem level, the emphasis largely being determined by the expertise of the PI involved. In a number of subjects a multidisciplinary approach is applied.

The productivity of the UoA is very high. Much of their research is published in the best microbiological journals, including Appl Environ Microbiol, Env Microbiol, FEMS Microbiol Ecol, Appl Microbiol Biotechnol, J Bact, etc). Occasionally, they publish in other high impact journals (PNAS, Nature Biotechnology). The group shows that fundamental in-depth research is possible on rather applied research topics. It should also be noticed that the productivity per researcher is lower than of other UoA's. It is difficult to get insight of the productivity and scientific quality of individual researchers within the UoA Microbiology. Some areas of research have a higher output, in quality and quantity, but it is not clear how the different researchers are distributed over the different research lines.

Many of the publications are very well received in the scientific community and they are very well cited. It is typical that the UoA is in most aspects in the bibliometric analysis slightly better than average. This implies that the impact of the research of the group is similar to research of other research groups that publish in the same journals. Likely some researchers are performing better than others and that the impact of the publications of these researchers is higher. However, the UoA has decided to have the large UoA evaluated as a whole.

In certain areas of research the UoA is at the forefront of microbiological science, but that prominence is diluted by other research, which nevertheless may be of high scientific quality.

The committee has the opinion that the scientific quality of certain parts would be high international, but that does not apply for the group as a whole.

On the basis of this evaluation, award a score from 1-6 ¹:

4

2. Recognition and Leadership

The UoA has taken the lead in pushing large research programs, like the DOM and MicroDriveE programs, which are important for research and application. These programs allowed to build a infrastructure for cultivation of microbes and chemical analyses. The UoA is participating in several national and international research projects. Recognition in the form of awards is not indicated, but invited talks are.

All the research projects are connected to health issues or biotechnological application. A large number of PhD's (about 30 %) found a position in industry or the public sector. In addition, a large number of patents (21) are awarded and submitted.

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

The UoA is recognized as an important scientific group as indicated by the large number of EU projects in which they participate. Some of the researchers have clear international recognition, this is not for all PI's the case yet. A large number of invitations as speaker at international and national conferences are indicated. However, it is not clear how these invitations are distributed over the academic staff.

Several publications in popular scientific journals have been published which shows the dissemination of their activities to society.

Overall, the leadership is good. It might be improved by obtaining personal national and international 'excellence' grants of staff researcher members or by obtaining awards of recognition.

The UoA was successful to obtain funding for applied research, with strong relevance for society. The committee recognizes the competence of leadership in that respect. However, a basic academic drive is important for university research groups. Leadership in that respect is not visible.

On the basis of this evaluation, award a score from 1-6 ²:

3. Relevance and Impact

The UoA has an impressive list of fruitful collaborations with companies and developments in the field of microbiology that are attractive for industrial partners or are suitable for generating new companies. The UoA research includes development of vaccines, starter cultures, probiotics, food production, biofuel processes, waste treatment, weed control. It also includes research in the field of environmental microbiology, in which basic controls in microbial processes relevant for the emission of the greenhouse gas nitrous oxide are identified.

A major effort is made with the development of processes and controls in generating biofuel (ethanol and biogas) from agricultural biomass. In the framework of the MicroDrive project (Microbially Derived Energy) about 20 researchers, PhD and MSc students investigate with a substantial financial input (50%) by industry the conversion of cellulosic material to usable energy and study the possibility of energy saving storage of crops used for bioenergy production. The partners from industry include Syngenta, Danisco-Genencor, Jästbolaget, Medipharm, Svensk Biogas, Chematur Engineering, Sala-Heby Energy, and Cambi AS. The UoA is also involved as a consultant for staff at municipalities, county governments, and biogas plants.

Another major effort is the DOM (Domestication of Microorganisms) program funded by Mistra involving 15 researchers and PhD students. The UoA has a long-term collaboration with the biotech company BioGaia. Basic research by the UoA resulted in the selection of bacterial strains that now are included in new probiotic products of the company. Removal of plasmids carrying antibiotic resistance genes allowed the commercial usage of the major probiotic strain. The food mycology group founded the spin-off company Olligon AB commercializing a patented soy tempeh-producing *Rhizopus* fungus. The development of stabilized lactic acid bacteria led to the collaboration with Medipharm AB, which produce starter cultures for silage production. Scientists of the UoA collaborate with BINAB AB on biocontrol by development of strain-specific markers used for studying survival, dispersal and competition of the *Trichoderma* species commercialized by the company.

² Recognition and leadership: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

The UoA is also collaborating with Nordvacc and novel companies (Biostapro AB, Intervacc AB) on the development of staphylococcal and streptococcal vaccines, e.g., vaccines against strangles in horses.

Finally, members of the UoA identify herbicides that are efficient in sustainable weed control on railway embankments supporting the Swedish railway administration (Banverket). The UoA filed 14 patents and submitted 7 patent applications, created 2 licences and 5 spin-off companies.

The collaborating and spinoff-companies are generally confined to within Sweden and Nordic/Europe. There are only few examples, where international companies (Glaxo, Inhibitex and XTL) bought licenses of filed patents.

The outreach of the UoA has a long-term perspective due to the application of products by commercialization.

The overall relevance of the UoA is scored being of utmost importance for the society in Sweden and Nordic countries.

On the basis of this evaluation, award a score from 1-6 ³:

4. Strategy and Potential

The strategy of the UoA for further research is basically a continuation of the existing strengths in the development of applicable microbial products, which still is a wide field for future discoveries and improvements. The research areas in particular focus on the following objectives: Investigation of the mechanisms behind the effect of probiotic bacteria and of the interactions between gut bacteria and their host; Microbial physiology under stress conditions relevant for the formulation of microbial products, such as starter cultures, or for the life of xerophytic fungi; Identification of key controls in the microbial production of biogas, isolation of microorganisms and optimization of process performance.

Another strategic focus is on microbial ecology. This research will tackle the ecological role of genetic variation at the population level within microbial communities of complex systems such as soil or gut environments. The idea is to understand the formation of ecological niches for microorganisms in the context of their evolution. This is an important strategic development which goes beyond the mere description of complex soil or gut systems towards a theoretical understanding. Besides these more fundamental aspects, the soil and gut systems provide models that are of practical importance for the society, either in the context of animal and human health and probiotic food production, or in the context of environmental health and global change.

The UoA has a rather large range of microbiological expertise both qualitatively and quantitatively, is well equipped with instrumentation and has many different collaborations with other institutes of the SLU, the industry and colleagues on an international basis. An important aspect is the collaboration with chemistry. Expertise and equipment of modern analytical chemistry as well as collaboration with solid state inorganic chemistry are of very high importance for microbiological research. Therefore, it will be of strategic importance to bring chemistry and biology together under the roof of the planned Bio-Center. However, it will be of great importance to keep the different chemical groups together as genuine chemical discipline with own chemistry-oriented RD programs to guarantee innovation and quality in this area. Separating the chemical groups and distributing them to different departments as service and support teams would not be helpful on a longer perspective.

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

The UoA is presently in the process of recruiting another faculty professor whose speciality will be in the field of microbial physiology. This will certainly add additional important expertise to improve the development of microbial applications. On the other hand, it is still unclear how the gap left by the leave of Professor Janet Jansson will be closed. A solution should be found soon.

As final argument, the UoA Microbiology is relatively well supported by funding and thus can keep a rather large number of researchers. This and the expertise of the staff create an excellent potential for the future of this UoA.

On the basis of this evaluation, award a score from 1-6 ⁴:

B 3. Performance of the Unit of Assessment against the Evaluation Criteria – *Environmental monitoring and assessment (FOMA)*

Not applicable

B 4. Actions for development at the Unit of Assessment

The self assessment of the Microbiology as whole gives the impression of a very successful opportunistic approach that resulted in good funding and substantial output of microbiological products that can be commercialized. This is without doubt a great achievement. However, the recognition of the Microbiology at SLU could be further increased if a strategic plan for a more fundamental development would be developed. This must not exclude later application, but should be an area in which microbiology in Uppsala serves as pacemaker on a global scale. This is presently not seen in the diversity of subjects.

There are probably several reasons for this lack in strategy. One reason may be the leave of Professor Janet Janssen. Another reason may be that the role of the other professors and lecturers at the department are not really clear. It is surprising that many of the persons on which the present strategic plan is based, belong to the researchers of the department, while some of the professors are not involved.

B 5. Additional information

The evaluation of the UoA Microbiology could have been more precise when the achievements and outputs could have been better affiliated to the individual organisational units. There is the impression that some of these units have a substantially higher productivity than others. Presently these are all lumped together into one average assessment.

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

R 3

SLU ur ett intressentperspektiv
(report from in-depth interviews with stakeholders;
in Swedish)

SLU ur ett intressentperspektiv

Report from in-depth interviews with stakeholders carried out by FBA Holding AB
(*in Swedish*).



Nybrogatan 15, 4 tr
114 39 STOCKHOLM

SLU ur ett intressentperspektiv

Diskussionsunderlag för intressentpaneler

Inledning

Denna text är tänkt att utgöra ett underlag till diskussioner om vilken nytta SLU skapar för intressenter, samt hur universitetets nuvarande och framtida inriktning bör betraktas ur ett intressentperspektiv.

FBA har på uppdrag av SLU intervjuat 27 personer, som på olika sätt är intressenter till SLU. Intervjupersonerna representerar myndigheter, näringsliv, intresseorganisationer och massmedia. FBA har använt en flexibel intervjuguide med inslag av såväl djupintervju som standardiserade typfrågor.

Dokumentet har delats in i tre delar. I den första presenteras de viktigaste resultaten från intervjuerna, med fokus på styrkor och svagheter samt vilken typ av nytta som SLU skapar enligt intressenterna. Del 2 handlar om de utvecklingsbehov som intressenterna tycker är viktigast för SLU att arbeta med. Till sammans med resultaten från del 1 presenteras en sammanvägd vision för hur intressenterna hoppas att SLU ska fungera i framtiden. Slutligen i del 3 formuleras ett antal diskussionsfrågor, som vi upplever är särskilt viktiga för SLU att ta hänsyn till ur ett intressentperspektiv.

Del 1 – så uppfattar intressenterna nyttan

1.1 SLU:s styrkor och svagheter enligt intressenterna

FBA har valt att presentera intervjupersonernas bild av SLU:s styrkor och svagheter enligt fyra teman och tio nyckelord. Den tematiska uppdelningen bygger på Högskoleverkets uppfattning om universitetets grundläggande uppgifter gentemot sin omgivning, i vid bemärkelse. Nyckelorden i sin tur är valda, utifrån forskning och erfarenhet, för att ge en så heltäckande bild som möjligt av de viktigaste egenskaperna hos ett lärosäte ur ett intressentperspektiv.

Teman

1. *Demokratiutveckling och samhällsdeltagande*
2. *Kunskapsutveckling*
3. *Kommersialisering*
4. *Rekrytering*

Nyckelord

1. *Expertis/kompetens*
2. *Anpassningsförmåga*
3. *Oberoende*
4. *Innovationsförmåga*
5. *Kapacitet*
6. *Interaktion*
7. *Förädling*
8. *Användbarhet*
9. *Genomslagskraft*
10. *Öppenhet/tillgänglighet*

I figuren nedan har intervjupersonernas synpunkter strukturerats utifrån hur de uppfattar SLUs styrkor och svagheter. Synpunkterna har också strukturerats

utifrån om de avser SLU:s *innehåll* och *inriktning* (rätt sak) eller om de fokuserar på SLU:s *arbetsmetoder* och *förhållningssätt* (rätt sätt).

Figur 1: Styrkor och svagheter

Rätt sak	<p>Expertis/kompetens Kunskapsutveckling Användbarhet Rekryteringsbas</p>	<p>Demokrati/samhälle Innovation Genomslagskraft Kommersialisering</p>
Rätt sätt	<p>Oberoende Öppenhet/tillgänglighet</p>	<p>Förädling Interaktion Anpassningsförmåga Kapacitet</p>
	Styrkor	Svagheter

En första bedömning av hur nyckelord och teman placerar sig i figuren visar att universitetets styrkor relaterar till "kärnverksamheten". Det handlar om att SLU uppfattas erbjuda en *oberoende kunskapsutveckling på hög nivå* och en viktig *rekryteringsbas* för intressenterna inom de områden där SLU är verksamt. Styrkorna beskriver i hög grad på vilka sätt nytta skapas för intressenterna idag.

Samtidigt lyfter intressenterna blicken och diskuterar nytta i ett större sammanhang, och på sikt, där SLUs bidrag i högre grad formuleras i termer av svagheter. Svagheter har det gemensamt att de till stor del handlar om SLU:s förmåga att skapa en *utökad nytta*: både fler *typer* av nytta för befintliga intressenter och nytta för *andra* aktörer än de som idag står SLU nära. Något förenklat skulle man kunna säga att nästan samtliga svagheter handlar om universitetets förmåga till *nytänkande* och *kommunikation/proaktiv interaktion*.

Undersökningen visar också att det finns en viss skillnad mellan intervjupersonernas upplevelse av SLU:s styrkor och svagheter idag, och hur man ser på styrkornas och svagheternas betydelse och potential. Detta styr också i hög grad vilka utvecklingsbehov intressenterna uppfattar som mest angelägna. Detta redovisas närmare i del 2 i detta dokument.

Styrkor

Vad kännetecknar intressenternas bild av SLU:s *styrkor*? Vi kan konstatera att styrkorna i hög grad sammanfaller med den praktiska nytta som SLU skapar för de valda intressenterna idag. Detta är logiskt, då intervjupersonerna har svarat utifrån sina personliga erfarenheter av kontakter med enskilda institutioner och forskare.

Expertis/kompetens

De intervjuade upplever att SLU:s kunskapsnivå och kompetens generellt är hög eller mycket hög inom de ämnesområden där de använder SLU. Bredden i SLU:s verksamhet gör dock att respondenterna inte kan uttala sig om helheten.

Kunskapsutveckling

Med kunskapsutveckling avses SLU:s förmåga att leverera relevant och användbar kunskap i form av exempelvis beslutsunderlag och policyutveckling för intressenterna. Detta anses vara den mest centrala nytta som SLU skapar idag. Sett till de egna behoven är intressenterna oftast mycket nöjda med SLU:s förmåga, djup och bredd. Betydelsen och utvecklingspotentialen för detta område anses vara mycket stor, men samtidigt beroende av hur andra teman, som genomslagskraft, förädling och interaktion, utvecklas.

Användbarhet

Intressenterna uppfattar att SLU i de flesta fall levererar för dem praktiskt tillämpbar kunskap och kompetens, med hög användbarhet. Detta sagt med utgångspunkt i att intressenterna, som myndigheter eller företag på olika sätt har "anlitat" universitetet för konkret dialog och uppdrag. De intervjuade är mer avvaktande när det gäller det vidare perspektivet, speciellt förmågan att skapa användbara resultat för fler personer och andra intressenter än de nuvarande. Vissa menar att SLU på den punkten ibland kan upplevas som alltför konservativt och med en för begränsad förmåga till förnyelse av kontakter och nätverk.

Rekryteringsbas

De myndigheter, organisationer och företag som idag använder SLU som rekryteringsbas är mycket nöjda med de studenter som SLU producerar. Flera sätter dock frågetecken för utbildningarnas "jordbruksstämpel" och menar att den styrka som finns i termer av kvalitet och relevans inte får genomslag i image och vision, vilket påverkar utbildningarnas attraktivitet. Betydelsen av en fortsatt stark rekryteringsbas är mycket stor för många intressenter, både när det gäller särskilda professioner som ex.vis veterinärer, och mer horisontella kompetenser som ex.vis ekonomer. Det bör dock framhållas att inte alla intressenter bedömer rekryteringsbasen som särskilt viktig eftersom man främst använder SLU för kunskapsutveckling och information.

Oberoende

SLU uppfattas av en majoritet intervjuade som oberoende och med stor integritet. Det anses viktigt med en objektiv röst, både i den egna verksamheten och i samhället i stort. Samtidigt befinner sig delar av SLU i en "egen värld" där många intressenter och forskare känner varandra sedan länge, vilket kan orsaka jävsituationer vid exempelvis fördelning av forskningsanslag, menar ett par personer.

Öppenhet/tillgänglighet

Intressenternas kontakter med SLU kännetecknas av en god dialog, där SLU uppfattas som hjälpsamma och tillmötesgående. Dock är det en mycket utbredd uppfattning att SLU är "öppna i tysthet", alltså att öppenheten och tillgängligheten förutsätter att intressenten själv tar initiativ till en kontakt.

Svagheter

Intressenternas bild av SLU:s *svagheter* är i många fall inte direkt kopplade till intressenternas egna kontakter och nytta. De intervjuade talar här snarare om en outnyttjad potential i den generella nytta man anser att SLU borde kunna skapa. Svagheter handlar bl.a om SLU:s relation till det omgivande samhället, och tillaktörer som idag inte har kontakt med SLU. Kort uttryckt så har respondenterna uppfattningen att SLU inte är så bra som man skulle kunna vara.

Demokrati/samhällsdeltagande

Ett flertal intressenter anser att SLU inte är synliga i samhället i tillräckligt hög grad. Det kan handla om att ha en större opinionsbildande roll, bedriva folkbildning, populärvetenskapliga publiceringar, etc. I detta ingår att göra forskningen begriplig och att kommunicera resultat till en bredare krets. Här lever inte SLU upp till intervjupersonernas förväntningar. "De sticker inte ut, de kunde delta mer i aktuella frågor" är en vanligt förekommande uppfattning. Flera menar att akademien generellt saknar tillräckliga incitament för sådan verksamhet, men att potentialen är mycket stor, och att det i förlängningen kan returnera en stor nytta till universitetet i form av ex.vis ökad legitimitet. Många menar att ett ökat samhällsdeltagande är en framtidsfråga av strategisk betydelse, i synnerhet då samhällets intresse för miljö- och livsmedelsfrågor, life sciencefrågor och en mängd andra områden inom SLUs hägn rymmer en möjlighet för SLU att bli en tongivande aktör.

Innovationsförmåga

Enligt intressenterna är inte SLU så innovativa som man skulle kunna vara. De intervjuade förväntar sig att SLU ska ligga mer i framkanten än vad man gör i kraft av att SLU:s verksamhetsområden har en sådan aktualitet och potential. Idag uppfattas SLU som onödigt konventionella, även om det varierar från ämne till ämne. Utvecklingspotentialen är stor. Intressenterna ser en möjlighet för SLU att öka innovationsförmågan genom att söka komparativa fördelar. Det innebär att fokusera på några områden och kombinera detta med ett ökat samarbete med andra lärosäten, istället för att försöka vara bäst på allt.

Genomslagskraft

Intressenterna menar att genomslagskraften för SLU:s verksamhet, både hos en vidare krets intressenter och i samhället i stort, är svagare än den skulle kunna vara. Den potentiella genomslagskraften i termer av affärsnytta, policypåverkan och liknande betraktas dock som stor. Ett första steg i rätt riktning vore, enligt intressenterna, att SLU blir bättre på att förmedla resultat och visa på vilken nytta man skapar.

Kommersialisering

Här anser intressenterna att SLU:s strategi och struktur måste bli tydligare. Många har svårt att uttrycka någon uppfattning om hur SLU arbetar med kommersialisering idag då man menar att SLU inte har någon tydlig profil på området. Frågan har samtidigt relativt liten betydelse för flertalet intressenter. Många företag har sin egen kommersiella verksamhet, och myndigheter är mer intresserade av beslutsunderlag och policyfrågor. Däremot företräder flera uppfattningen att SLU självt borde kunna ha en mer aktiv roll i att få ut viktiga produkter och tjänster på marknaden, eftersom universitetet verkar inom för nya näringar och hållbar tillväxt viktiga områden.

Förädling

Paketering av kunskap och förmedling av forskningsresultat är olika aspekter av förädling där intressenterna anser att SLU är svaga idag. "De sitter på mycket bra kunskap som inte kommer ut" är en formulering som illustrerar uppfattningen hos flera. Utvecklingspotentialen bedöms som mycket stor, eftersom det ofta handlar om att kommunicera befintlig kunskap på ett effektivare sätt.

Interaktion

Intressenterna saknar en tydlig initiativförmåga från SLU, både gentemot myndigheter och näringsliv, men också i förhållande till den akademiska världen. SLU som helhet måste, enligt de intervjuade, bli bättre på att ta del av andras kompetens och alliera sig med andra forskningsområden. Interaktionen måste ske mer proaktivt från SLU:s sida och i linje med en tydlig vision och strategi.

Anpassningsförmåga

SLU uppfattas som lyhörda och bra i dialogen mellan enskilda forskare och intressenter, men på övergripande nivå brister förmågan att "lyfta blicken, sticka ut hakan eller sätta ner foten" som en intervjuperson uttrycker det. Intressenterna betonar också att det är stor skillnad mellan att anpassa sig till enskildas önskemål, och att anpassa sig till en föränderlig omvärld mer generellt. Det senare är minst lika viktigt och kan samtidigt ge stöd för en balansering mellan det dagsaktuellt opportuna, och den mer framåtsyftande nyfikenheten och oberoendet, liksom förmågan att sätta agendan, inte bara följa den.

Kapacitet

Flera intressenter resonerar kring såväl geografiska som mentala avstånd mellan fakulteter och institutioner. För många av de starka ämnesområdena är kapaciteten mycket god. Respondenterna hyser dock en oro över vad de uppfattar som en bristande förmåga att kraftsamla och konsolidera, dels över ämnesgränserna, men också i förhållande till andra lärosäten.

1.2 Hur skapar SLU nytta för intervjupersonerna själva i deras yrkesroller?

Intervjuerna visar att SLU skapar stor nytta för sina intressenter med utgångspunkt i en relativt traditionell roll. SLU anses vara duktiga och ha en levande relation till sina huvudområden, vilket för intressenterna innebär att **tillämpbarheten** i dessa fall är stor och nyttan konkret. Intervjupersonerna upplever att den allmänna utvecklingen inom näringar såsom t.ex. viltforskning, skogsnäring, jordbruk etc. på många sätt har gynnats som en direkt följd av SLU:s forskning och utbildningar på området. SLU utmärker sig väl och har stor betydelse för yrkesverksamma inom lantbrukssektorn, genom att tillföra **kunskap** till gagn för såväl effektivisering som affärsutveckling.

Intervjupersonerna återkommer ofta till att en betydande del av nyttan handlar om deras möjlighet att **konsultera experter** och få professionella utlåtanden inom områden där de själva har begränsad kunskap. Studien visar dessutom att de flesta intervjupersonerna anser att det är lätt att komma i kontakt med forskare på SLU för att få svar på frågor, och att det generellt finns ett intresse för diskussion på universitetet. Det finns alltså en vilja och ett intresse att **ställa upp** och sprida kunskap, när intressenterna hör av sig i en viss fråga.

En stor del av den nytta som intervjupersonerna beskriver handlar om **forskning och kunskapsframställning**, och detta betraktas återkommande som SLU:s starkaste sida. Kunskapen kan i vissa fall användas genom att sammanlänkas med aktörer som tillämpar forskningen praktiskt genom exempelvis produktutveckling, eller som beslutsunderlag i diverse frågor. Aktörer som genom anslag finansierar delar av SLU:s forskning ser nyttan i form av uppnådda resultat, som därigenom blir till direkt och mätbar nytta.

Rekryteringen av studenter och forskare skapar en direkt nytta för flera intressenter. Intervjuerna indikerar dock att SLU främst verkar som rekryteringsbas inom kunskapsintensiva branscher. Inom mer praktiska områden har SLU inte samma tyngd som rekryteringsbas, eftersom utbildningarna av vissa betraktas som något teoretiska utan tillräcklig praktisk tillämpning eller tillräcklig hänsyn till olika branschers behov.

1.3 Hur anser intervjupersonerna att SLU skapar nytta i bredare bemärkelse?

Institutioner som finansierar forskning, och organisationer med stort behov av kunskapsutveckling inom olika områden, menar att SLU skapar nytta i samhället på ett bredare plan genom att forskningen bidrar till en **fördjupad diskussion i samhället**. En levande diskussion påverkar beslutsfattare och får genomslag i media, vilket i sin tur har betydelse både för SLU:s och de gröna näringarnas synlighet och attraktivitet. Dock menar flera av intervjupersonerna att SLU hållit låg profil under senare tid och inte synts tillräckligt i den offentliga debatten, trots att intresset för potentiella "SLU-frågor" kan anses vara större än på länge.

Flertalet intervjuade menar att SLU, trots möjligheten att vara en tongivande aktör inom sina ämnesområden, har **halkat efter** inom exempelvis klimatforskning, livsmedelssäkerhet, etc. Många intervjupersoner efterfrågar en utökad **omvärldsanalys** för att ligga i framkant när det gäller nya trender och behov i samhället. Samtidigt efterfrågas ett bredare nyttoperspektiv där SLU:s forskning paketeras, görs begriplig och sätts in i ett större sammanhang. Exempelvis livsmedelskedjan länkar samman många forsknings- och näringslivsområden, där inga delar kan verka isolerade från varandra.

Detta breda perspektiv på nytta är ofta kopplat till **indirekt**, snarare än direkt, nytta, och det är detta som intervjupersonerna menar är SLU:s svaga sida. Denna indirekta nytta är viktig för SLU då den på sikt kan skapa nya former av direkt nytta hos nya typer av intressenter. Respondenterna ser således en fara i att SLU nöjer sig med att befintliga intressenter får det de vill ha.

1.4 Vad beror de olika uppfattningarna mellan egen nytta och övergripande nytta på?

Intressenterna uppfattar ofta den egna nyttan som stor när det gäller SLU:s expertis inom ett visst **sakområde**, såsom t.ex. ren- eller skogsnäringen. Den nära kopplingen till själva näringen/sakområdet gör nyttan konkret och tillämpbar. Den egna nyttan är också stor när kunskapen kan användas i dialog med beslutsfattare i syfte att stärka sin position i en viss fråga eller område.

Övergripande nytta kan handla om samhällsfenomen, som t.ex. bidrar till långsiktig kunskapsutveckling inom ett större område, eller till att i förlängningen bidra till hållbar utveckling, strukturomvandling av lantbruket eller liknande. Det finns då inte alltid en lika tydlig koppling till en viss näring eller till ett sakområde. Bred nytta är därför oftare mer indirekt än egen nytta och kan vara mer **svårgreppbar** och svårare att mäta och värdera.

En annan typ av bredare nytta är forskningsområden där resultaten kommer först på lång sikt. Intressenterna kan då se en förväntad nytta, även för dem själva, men menar att den är svår att uppskatta och värdera, framförallt som vardagen, i såväl näringsliv som förvaltning, ger ett fokus på resultat i ett kortare **tidsperspektiv**.

De svagheter som de intervjuade lyfter fram handlar om att SLU inte fullt ut tagit samma helhetsgrepp kring de "nya" områden och potentiella intressenter som vuxit sig starka under senare år, i jämförelse med den tyngd man har inom sina "traditionella" områden. Respondenterna betonar att det är nödvändigt att SLU diskuterar vilken typ av universitet man ska vara, och är beredda på att olika intressekonflikter kan uppstå. En sådan "konflikt" bär samtidigt fröet till den efterfrågade förmågan till innovation och förnyelse av verksamheten.

Del 2 – vägen framåt

2.1 Utvecklingsområden enligt intressenterna

Det finns en stor enighet bland intressenterna om de viktigaste utvecklingsbehoven för SLU, oavsett vilken typ av verksamhet man representerar. Nästan alla önskemål är relaterade till kommunikation, interaktion, paketering, image, och liknande.

En mer proaktiv kommunikation av verksamhet och forskningsresultat

Intressenterna efterfrågar en mer aktiv och genomtänkt forskningskommunikation och kunskapspridning. SLU bör se över hur man kan utveckla former för en kontinuerlig dialog med slutanvändaren av forskningen. Redan i planeringen av ett forskningsprojekt skulle SLU kunna föra en diskussion med slutanvändare, t.ex. genom referensgrupper. Idag är publiceringsplaner och liknande bristfälligt beskrivna och kommunicerade. Flera intervjupersoner menar att det finns för få incitament för forskare på SLU att vända sig utåt med sina resultat. Det akademiska meriteringssystemet beskrivs som en tänkbar orsak till detta. (vår anm: vilket är en generell problematik i universitetsvärlden).

SLU är enligt de flesta intressenter lätta att samarbeta med när intressenterna själva tar kontakt. Forskarna uppfattas som samarbetsvilliga och har bra kunskap, men den aktiva kommunikationen är svag. Det finns heller inget tydligt ansikte utåt. Därför blir det problematiskt för nya intressenter att söka sig till SLU.

SLU bör alltså vara mer offensiva och proaktiva i sin kommunikation/pressverksamhet, och "ligga steget före" behov och efterfrågan. Intressenterna menar att SLU borde våga visa upp sig mer och visa hur bra man är, och anser att flera

andra universitet som man samverkar med har skaffat sig ett försteg här. De intervjuade menar att SLU har goda möjligheter att skapa en efterfrågan på sina tjänster bara genom att synas, vara med i nätverk och liknande.

Sammanfattningsvis uppfattar många intressenter att det finns kunskap på SLU som många aktörer skulle ha nytta av, men som de inte vet om. Dessa aktörer vet alltså inte att de skulle kunna ha nytta av SLU. SLU bör således ta ett mer strategiskt grepp kring hur nyttan kan marknadsföras och realiseras, både mot gamla och nya aktörer.

Paketera verksamheten för ökad tillämpbarhet och genomslagskraft

Ur ett intressentperspektiv räcker det inte alltid med att forskningen håller en hög vetenskaplig kvalitet. SLU måste också kunna koppla ihop sina forskningsområden i ett större sammanhang, till exempel genom systemanalyser. Respondenterna uppfattar syntesverksamheten som mycket viktig. Det handlar om att bidra till att "lägga pusslet", inte bara ta fram pusselbitarna. Intressenterna tror att tillämpningen och genomslagskraften för SLU:s verksamhet skulle kunna vara avsevärt högre om man lyckades presentera och paketera information på ett bättre sätt än idag.

Omvärldsanalys och behovsanalys

Många intressenter menar att SLU behöver satsa mer på omvärldsanalys för att bli mer "på bettet" och vitalisera SLU:s position i samhället. Detta bör ske i samverkan med andra lärosäten, myndigheter och näringsliv. Från näringslivets sida anser flera att SLU behöver en tydligare vision om näringarnas hållbarhet och tillväxt. Man bör föra en dialog med nya, gamla och potentiella näringsområden och intressenter, till exempel genom olika former av programråd.

Samverkan och effektivisering; såväl internt som med andra lärosäten

Intressenterna framhåller behovet av att SLU skapar synergier mellan olika delar av SLU och med andra lärosäten. Detta är viktigt för att SLU ska kunna hantera en allt starkare global konkurrens på marknaden för kunskap och kompetens. SLU bör enligt respondenterna inta en ödmjuk hållning, men samtidigt visa på tydliga spetsar, med utgångspunkt i att SLU inte kan vara bäst på allt. I synnerhet inte inom det breda (allt bredare) område man försöker täcka.

När det gäller SLU:s interna samverkan vill de intervjuade möta ett samlat SLU. Flera refererar till "tjafs" över fakultetsgränser, liksom fragmentering och en känsla av att olika delar av SLU dubblerar varandra. Ett förslag som förs fram är att SLU inventerar vilka/hur många som jobbar med olika områden, ex. livsmedel, och vilken kunskapsplattform och grundläggande forskningshypoteser som området rymmer. Ur effektivitetssynpunkt anser några intressenter att det gäller för SLU att inte ha en "för stor kostym". De påpekar t.ex. att det inte är ett självändamål att ha många studenter, särskilt om det inte finns en idé om vilken/vilka arbetsmarknader dessa ska verka inom.

Tydligare identitet och profil

Många av intressenterna vill att SLU reviderar och ser över sin profil och image gentemot samhället och näringslivet. SLU bör också fundera på sin identitet i den internationella konkurrensen, och positionera sig tydligare i förhållande till denna. SLU måste också resonera kring sin sektorsroll. Ska man vara ett tillämpat yrkesuniversitet eller ett akademiskt excellent universitet?

Trenden generellt är att universiteten blir mer profilerade, och kvalificerar det externa samarbetet/samproduktionen. SLU har enligt de intervjuade ett unikt läge att förtydliga och se över befintliga och potentiella profiler och intressenter, och bör kritiskt granska risken för att bli alltför utslätade eller att missa viktiga avnämare och medaktörer.

SLU borde också ha goda möjligheter att öka attraktiviteten gentemot blivande studenter. Flera av intressenterna menar att SLU:s undervisningskvalitet, lärartäthet, utbyten etc. håller en hög klass, men att man lyckas inte förmedla det till potentiella studenter.

De intervjuade trycker på betydelsen av att SLU uppdaterar begrepp och egna föreställningar i syfte att inte "fastna" i en traditionell bild av lantbruket och kunna kommunicera sina tillgångar i en kontext som rymmer fler och andra intressenter, och gamla intressenter med nya behov.

2.2 Bilden av SLU:s verksamhet och erbjudande: Mindre fokus på den traditionella ämnesindelningen och mer fokus på sammansatta, tematiska styrkeområden

Redovisningen ovan har fokuserat på hur intressenterna ser på styrkor, svagheter, nytta och utvecklingsbehov för SLU. Vi kan konstatera att SLU på flera viktiga områden är till stor nytta för intressenterna själva, utifrån deras respektive intresseområden och verksamheter. Men intressenterna har också beskrivit ett SLU som inte tillräckligt aktivt har sökt en position inom nya och aktuella områden där man inte redan är starka. De beskriver ett SLU som skulle kunna skapa nytta för fler om man kommunicerade sin verksamhet på ett annat sätt.

I det följande beskriver vi en tänkbar utveckling av SLUs position och hur den kan uppfattas av omvärlden. Utgångspunkten för ett sådant utvecklingsscenario är balansen mellan två "identiteter". **Identitet A** står för den traditionella ämnesindelningen på SLU, vilket också till en del representerar universitetets funktionella organisation. **Identitet B** bygger i grunden på de styrkeområden som SLU själva har identifierat. Områdena i Identitet B representerar inte en strikt indelning i ämnen, utan står istället för ett antal teman som till sin natur angränsar till många andra akademiska områden och aktörer.

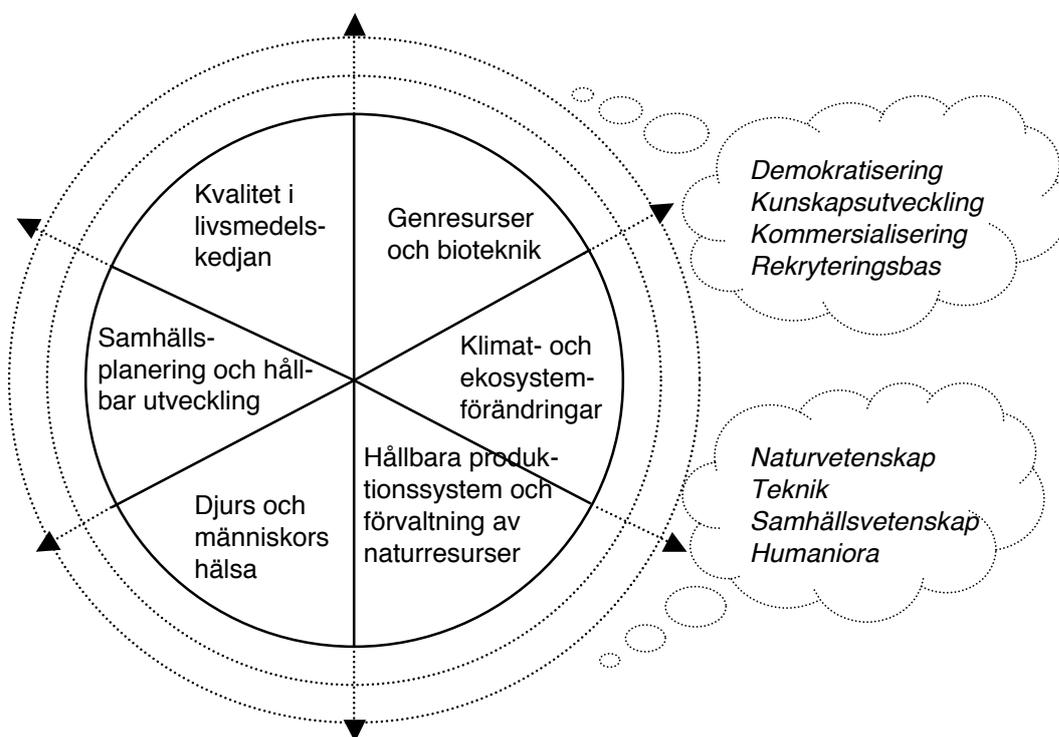
Identitet A är den bild som bäst beskriver hur intressenterna ser på SLU idag. Den traditionella ämnesindelningen fungerar bra för de intressenter som verkar inom respektive område och dess delar. För befintliga intressenter kan denna indelning vara en stor fördel, som förenklar kontakten med SLU. Det finns heller inte anledning att ifrågasätta dess roll för SLU:s organisationsstruktur. Men som *extern identitet och image* gentemot omvärlden begränsar Identitet A möjligheterna för SLU att skapa nytta inom nya och mer komplexa områden som överskrider ämnesgränserna.

Figur 2: Identitet A – SLU:s traditionella ämnesindelning

	Jord och trädgård	Husdjur	Livsmedel
	Skogsbruk	Miljövård	Samhällsplanering

Identitet B är en utveckling av de styrkeområden som SLU självt har identifierat. Den tematiska indelningen är ett sätt att beskriva hur SLU:s verksamhet spelar en viktig roll i komplexa och aktuella frågor som spänner över flera akademiska fält och som har stor politisk och affärsmässig relevans. Detta är den bild som intressenterna önskar att SLU blev bättre på att verka inom och förmedla till sin omvärld!

Figur 3: Identitet B – SLU:s styrkeområden och deras koppling till ett bredare sammanhang



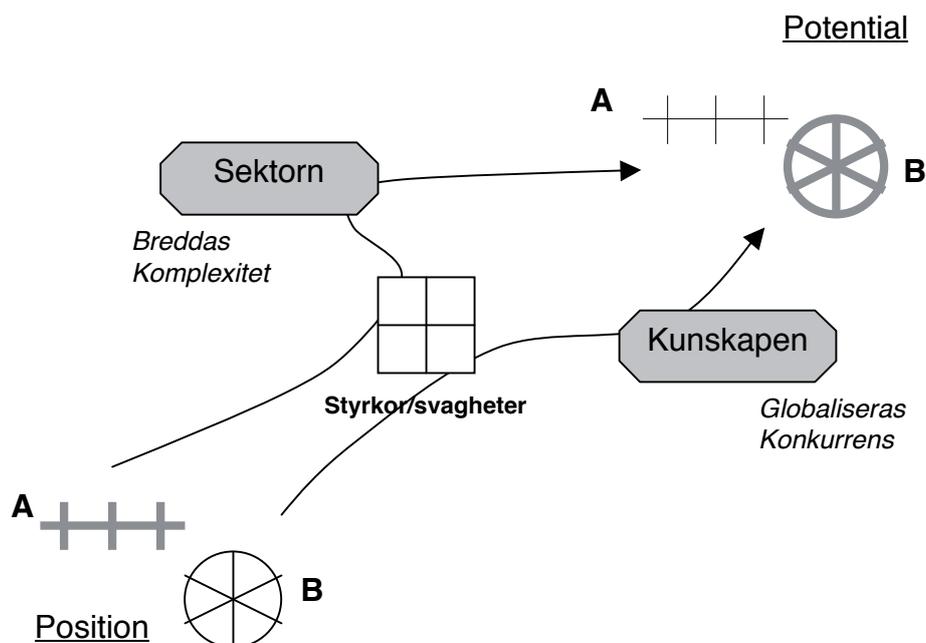
Intressenterna efterfrågar alltså en utveckling mot ett SLU som aktivt lyfter fram Identitet B. SLU kan på detta sätt kommunicera att man är ett universitet som har en viktig roll att spela i frågor som berör många människor. Samtidigt placerar man sig själv i ett sammanhang som är större än universitetets gränser. Identitet A kvarstår, men får en mindre framträdande roll.

2.3 Visionen om framtidens SLU: Vägen från Lantbruksuniversitetet till ett SLU i tiden – Hur skapas det SLU intressenterna efterfrågar?

Föregående avsnitt visar att utvecklingen mot ett SLU med större intressentnytta till stor del handlar om att se över vilken identitet man kommunicerar utåt. Idag dominerar det som vi här kallar för identitet A medan identitet B enligt intressenterna inte syns tillräckligt. SLU bör i "paketeringen" av forskningsresultat och annat förmedla att man kan och vill erbjuda kunskap som ingår i högaktuella sammanhang och som har stor relevans för fler intressenter utöver de redan etablerade.

För att uppnå den identitet och position som intressenterna efterfrågar krävs att SLU förmår utnyttja sina styrkor och parera sina svagheter i förhållande till de yttre hot, risker och möjligheter som kan fungera som med- och motkrafter på vägen. Till de externa krafterna hör att sektorn breddas alltmer och blir mer komplex, samt att kunskapen globaliseras och blir mer konkurrensutsatt. Därtill kommer interna krafter som kan främja eller hindra vägen framåt, ex.vis strategier, meritiering, finansieringsmodeller, rekryteringspolicy etc.

Figur 4: Intressenternas bild av vägen till ett SLU som skapar större nytta för fler



Bilden visar en väg från en position där identitet A dominerar och där identitet B existerar, främst som potential, men inte kommuniceras aktivt gentemot intressenterna. Målet för intressenterna är att förhållandet snarare ska vara det omvända. Vägen dit innefattar ett antal avvägningar i förhållande till universitetets styrkor och svagheter. Hanteringen av styrkor och svagheter bygger i sin tur till stor del på att SLU genomför en omvärldsanalys som förmår beskriva hur sektorn där SLU verkar kommer att utvecklas, samt hur kunskapen som SLU skapar står sig i förhållande till den globala forskarkonkurrensen. Den tematiska indelningen som identitet B uttrycker är en god beskrivning av hur den sektor där SLU verkar har blivit allt mer komplex och bred, vilket är både ett

hot och en stor möjlighet. SLU är heller inte längre ensamma om att producera den typ av kunskap man betraktar som sin kärnverksamhet. Idag finns det en ökad konkurrens från andra lärosäten, såväl nationellt som internationellt.

Del 3: Frågor till panelerna att diskutera

Övergripande frågor

- Är undersökningens övergripande bild av SLU:s styrkor och svagheter korrekt?
- Hur värderar ni betydelsen av styrkor resp. svagheter?
- Vilka är SLU:s konkurrenter?
- Vilka är SLU:s potentiella intressenter, som inte använder sig av SLU idag?
- Vilken profil bör SLU ha? (jmf. identitet A resp. B)
- Vilka är de mest angelägna utvecklingsbehoven för SLU (givet val av intressenter och identitet)?

Mer detaljerade frågor

Hur ser ni på:

- SLU:s omvärldsbevakning? (vad, hur)
- SLU:s konkurrensförmåga? (position)
- SLU:s medverkan i samhällsdebatten? (omfattning, inriktning, form)
- SLU:s nytänkande/innovativitet? (förmåga, angelägna områden)
- SLU:s paketering/förädling av kunskap? (former, områden)
- SLU:s kommunikationsstrategi? (innehåll, former)
- SLU:s attraktivitet för studenter? (utbildningsstrategi)

Vision

- Om SLU inte existerade idag:
 - Skulle ett SLU behöva inrättas?
 - Vilken profil skulle det då ha?
 - För vilka skulle det existera?
 - Vilka områden skulle vara prioriterade?
 - Vilka akademiska partners vore relevanta?

Intervjuade intressenter till SLU

FBA 2009-06-10

Stefan Källman	Ämnesråd, Jordbruksdepartementet
Erik Arnberg	Miljödepartementet
Harald Svensson	Chefsekonom, ledningsgruppen, Jordbruksverket
Erik Fellenius	Chef på FoU-sekretariatet, Naturvårdsverket
Håkan Wirtén	Verksledningen, Skogsstyrelsen
Anna Lundborg	Handläggare, Energimyndigheten
Göran Tunhammar	Landshövding, Länsstyrelsen Skåne
Stuart Slorach	F.d. Livsmedelsverket
Lars Hågbrandt	Samhällsbyggnadsdirektör, Linköpings kommun
Björn Sundell	Planeringschef, Statens Veterinärmedicinska Anstalt
Torsten Andersson	Jordbruksansvarig, Sida
Hans-Örjan Nohrstedt	Strategi & analys, Formas
Jan Fryk	VD, Skogforsk
Eemonn Connolly	Forskningschef, BioGaia
Björn Hägglund	F.d. VD Stora Enso
Åke Clason	VD, Hushållningssällskapens förbund
Bo Stark	VD, Väderstad
Ole Lind	Forskningsansvarig, DeLaval
Bengt Persson	Ledamot i LRF:s, JTI:s, SLF:s styrelser, mm.
Annika Bergman	Ordförande, Sveriges Grisproducenter
Lars Hagel	Dir. Ext. Relationer R&D GE Healthcare
Anders Blom	Förbundsdirektör, Svenska Samernas Riksförbund
Nils Palmgren	Ordförande, Mäster Grön
Louise Ungerth	Konsumentföreningen Stockholm
Lars Idermark	VD, Coop-Forum
Susanna Baltscheffsky	Svenska Dagbladet
Jan-Olov Johansson	Journalist, frilans

R 4

Reports from Stakeholder panels (in Swedish)

Reports from Stakeholder panels (in Swedish)

I. Livsmedel (Food)	501
II. Djurhälsa och djurvälstånd (Animal Health and Welfare)	510
III. Energi- och industriråvaror (Raw Materials for Energy and Industry)	519
IV. Samhällsplanering, natur och miljö (Spatial Planning, Environment and Nature)	529
V. Fortlöpande miljöanalys, Foma (Environmental Monitoring and Assessment)	537

Rapport från intressentpanel

I. Livsmedel

A. Sammanfattande bedömning för området

Vad som levereras

Inom Panel I. Livsmedel anses nytta av forskning uppkomma vid samarbete mellan forskningen på SLU och näringen. Därför bedöms en framgångsfaktor vara strukturerade program, där de olika parterna kan mötas och utbyta erfarenheter. I dag finns en del sådana mötesplatser vid SLU, såsom till exempel centrumbildningar, men generellt sett behöver dessa bli fler till antalet.

Det finns emellertid potential till förbättringar genom att införliva ett antal forskningsområden till SLUs verksamhet. Dessa områden rör exempelvis mer produktionsorienterad forskning, det vill säga till de mer traditionella agrara ämnesområdena till exempel växtproduktionslära, ekonomi, ekologisk produktion, systemanalys, management samt vattenfrågor.

Vidare anses det att kopplingen till lantbruksnäringen måste understrykas mer i framtiden. Lantbruket är en vital del av det moderna samhället och viktigt för utvecklingen av det hållbara samhället.

Hur kunskapen utvecklas, paketeras och förmedlas

Generellt anser vi att SLU bedriver intressant forskning på många håll men vi ser alltför liten realisering av forskningen i praktiken.

Samarbeten i olika former mellan intressenter i näringen och forskare på olika lärosäten är en viktig komponent för att kunna förmedla forskning. Det finns idag flera exempel på forskningsenheter och projekt som är framgångsrika och som genererar funktionell kvalitet såsom till exempel PartnerskapAlnarp, FältForsk, PlantCom Mistra, Welfare Quality samt MeNY.

Vidare bör SLU ha en kommunikationsstrategi för att informera om resultat från forskningen. Vi rekommenderar därför att SLU ska säkerställa resurser för att hantera den externa kommunikationen. Genom att öka kontaktytan och relationerna med näring och intressenter och samhälle ökar därmed nyttan av SLUs verksamhet.

Ansvaret för den externa kommunikationen bör vara tydligt organiserat med befogenhet både för övergripande ledning och fakulteterna både för att stimulera kommunikationen in till SLU och informationen och diskussionen ut mot näringen och samhälle.

SLUs image

Enligt vår bedömning uppfattas SLU av andra universitet såsom ett bra universitet med goda finansieringsmöjligheter och resurser. Primärproducenter ser på SLU som ett lantbruksuniversitet, men som håller på med annat än jordbruk. Enligt vår bedömning gäller inte motsvarande uppfattning på skogsområdet. Allmänheten ser SLU som ett universitet som har ett stort miljöengagemang.

Generellt kan sägas att SLUs kärnfrågor är idag i fokus för samhällsdebatten, till exempel klimatförändring, bioenergi och livsmedelsförsörjning, men det är inte SLU och den publika

framtoningen av SLU är något man måste jobba på inför framtiden.

Vi bedömer att SLU:s geografiskt spridda lokalisering ger en styrka genom den lokala närvaron men kan å andra sidan försvåra byggandet av en gemensam image. Vidare anser vi att namnet Sveriges Lantbruksuniversitet är värdefullt att behålla eftersom lantbruket av idag är en vital del av det moderna samhället och viktigt för utvecklingen av det hållbara samhället.

Att diskussionen om det ekologiska lantbrukets vara eller inte vara är den enda där SLU-forskare blir riktigt synliga i samhällsdebatten – med eko-kritiska ståndpunkter - är inte positivt ur image perspektiv.

Framtiden

Stora utmaningar för SLU inför framtiden är att göra strategiska prioriteringar vad gäller vilka områden inom life science som ska satsas på: man kan inte vara bäst på allt. I arbetet med detta ingår att identifiera styrkor och svagheter för att komplettera och eventuellt ersätta den forskning som finns idag. Detta innebär i realiteten en balansgång då man bör säkerställa att den forskning och utbildning som efterfrågas idag finns i Sverige.

Ett framtida mål bör också vara att det bedrivs forskning med ett holistiskt, tvärvetenskapligt synsätt, längs hela livsmedelskedjan. Detta innebär inte nödvändigtvis att all denna forskning måste ske inom SLU. Men SLU kan vara den ledande parten, som genom initiativ och ledarskap säkerställer kontinuitet samt styr och utvecklar projekt och processer. Med ett starkt ledarskap och fokus på viktiga områden och säkerställa kontinuiteten i projekt kan SLU inte bara bli ledande inom sina forskningsområden utan också ha ett viktigt bidrag i samhällsdebatten.

En värdefull strategi för att erhålla ökad nytta genom forskningen i framtiden är att göra forskningen relevant för intressenter. Ett led för att uppnå detta är att göra arbeten inom UoA och andra grupperingar som ej bedriver direkt forskning mätbara då dessa idag kan ej värderas enligt samma mall som forskande enheter. Här krävs det därför ett utvecklande av ett eget meritvärderingssystem.

B 1. Teknisk kvalitet och relevans

För att erhålla en bra och relevant forskning som genererar nytta till näringen och samhället i stort bör ett samarbete främjas mellan forskningen och näringen. En framgångsfaktor är därför att de respektive parterna möts inom ramen för strukturerade program. Styrkor inom SLU idag är sådana samarbeten i olika former.

Goda exempel utgörs av:

- SLU har genom åren på ett mycket värdefullt sätt genom forskning och informationsarbete deltagit i arbetet med att göra jordbruket mer uthålligt och för att nå våra miljömål. Exempel på forskningsområden är åtgärder för att minska övergödning och för att bevara den biologiska mångfalden i våra betesmarker.
- Ett bra projekt på SLU bedrivs inom området spannmål och dess funktionella kvalitet. Denna typ av forskning har bidragit till ett generellt högre medvetande i samhället för spannmålets positiva hälsoeffekter.

- Framgångar har också nåtts inom området genetik och förädling av äppelsorter. På Balsgård har man på ett framgångsrikt sätt lyckats att ta fram nya äppelsorter anpassade till svenska förhållanden i samarbete med odlare. I detta sammanhang bör även förädlingen av havtorn lyftas fram.
- Forskning om klimatanpassning av växthusodling med en övergång till uppvärmning av växthus med hjälp av bioenergi har lett till att svensk odling i växthus har blivit världsledande.
- Feromonforskningen är ett bra exempel på grundforskning inom SLU/LU som har gett möjligheter till värdefull tillämpning inom industrin.
- Mikrobiologerna arbetar problemorienterat genom att anpassa grundforskningen till tillämpningsområdena och har därmed anpassat sin forskning efter näringens behov (till exempel DOM-projektet och MicroDrive).
- Förutsättningar för att ersätta kemiska betningsmedel med biologiska betningsmedel har möjliggjorts genom forskning på SLU. Dessa resultat används idag kommersiellt.
- Listeriaforskningen inom området livsmedelshygien har genererat värdefull kunskap för näringen och dessa resultat används idag av både industri och myndighetsarbete.
- Projektet ”Welfare Quality”- ett EU-projekt med syfte att utveckla kriterier för bedömning av djurens välfärd.
- Forskningen inom ämnet jordbearbetning resulterar i kunskap som implementerats i praktiken. Detta uppnås genom att både grundläggande forskning och mer tillämpad forskning bedrivs parallellt, dessutom sker forskningen i nära relation med ett brett intressentnätverk.
- Forskning inom genetik och avel på SLU bedriver enligt vår bedömning en bra och relevant forskning på animaliesidan.

Generellt anser vi att SLU bedriver intressant forskning på många håll men vi ser alltför liten realisering av forskningen i praktiken. En orsak kan vara att det inte är tillräckligt meriterande för SLUs forskare att engagera sig i praktisk tillämpad forskning. SLU måste ändra på detta.

Förbättringspotentialer:

- Vi saknar i allmänhet en mer produktionsorienterad forskning. Det har under många år saknats strategiskt viktiga professurer inom områdena växtodlingslära och lantbruksteknik. Det saknas idag även utbildning inom det teknikagrara området. Vi anser att forskning inom växtodlingsproduktion måste framhävas i mycket större utsträckning än vad som görs idag. Man behöver dessutom skapa djupare kunskapsresurser inom genetik på växtodlingssidan.
- Vi efterlyser också en ekonomisk forskning rörande svensk livsmedelsproduktion i hela kedjan. Det saknas internationella jämförelser, konkurrensanalyser för primärproduktionen och utvecklingsmöjligheter för förädlingsindustrin. Vidare behövs konsekvensanalyser av jordbrukspolitiska beslut och förändrade produktionsmetoder, till exempel ekologisk produktion, specifika svenska djurhållnings kriterier, beteskraav samt burstorlekskrav. Konsekvenser som bör studeras kan röra miljöeffekter, sysselsättning, lönsamhet för producenter samt välfärd för konsumenter.
- Forskning kring riskanalytiska principer och användning av dessa inom livsmedelsforskningen

saknas i princip helt idag. Avsaknad av denna typ av forskning är, enligt vår mening, en allvarlig brist inom SLUs forskningsområden.

- Den ekologiska produktionen växer all snabbare båda i Sverige och internationellt. Vi anser att SLU inte satsar tillräckligt på forskningen inom denna produktionsform i syfte att effektivisera den. Sådan forskning kan komma till nytta även för den konventionella produktionen.
- Man bör också stimulera långvarig tvärvetenskaplig forskning rörande managementfrågor exempelvis samspelet mellan människa, teknik och djur.
- Ett viktigt forskningsområde är vattenfrågor. Hydrologi och vattenbruk riskerar att bli bristfälliga forskningsområden vid SLU. Ett lantbruksuniversitet borde ta sig an dessa områden inför en kommande klimatförändring.
- I dagligvaruhandeln finns idag väl utvecklade och forskade logistiska system för den storskaliga livsmedelsproduktionen och motsvarande forskning saknas för den småskaliga produktionen. Om den småskaliga produktionen ska tillåtas utvecklas till en högre nivå än idag krävs standardiserade, automatiserade lösningar för beställning och fakturering, som är enkla och prisvärda för små leverantörer. Den småskaliga produktionen har därför behov av forskarstöd för att utveckla genomtänkta systemlösningar som möjliggör effektiva leveranser av kvalitetssäkrade produkter till dagligvaruhandeln. SLU borde därför jobba mer med modellutvecklingar av logistik och ha en djupare förståelse för system och logistik inom området livsmedelssäkerhet. Samordnade transporter är nödvändiga både av ekonomiska och miljömässiga skäl. Småproducenterna har inte möjlighet tillägna sig det på egen hand och i dagens samhälle efterfrågas denna typ av tjänster starkt. Om denna typ av kunskap redan finns på SLU vet man inte var den finns och var man ska vända sig efter denna kompetens. Vi vet att det i dagsläget på SLU finns sådana system för biobränslehanteringssystem.
- Avsaknaden av en systematisk forskning och analys av de lantbruksnära branscherna (mjölk, kött etc.) skapar osäkerhet om den relativa konkurrenskraften och uthålligheten. En fördjupad kunskap inom detta område skapar ett bra underlag för den offentliga debatten om jordbruksnäringens framtida utvecklingsvägar.

B 2. Funktionell kvalitet

Nytta hör i allra högst grad ihop med hur forskningsresultaten implementeras i praktiken. Det finns många viktiga och intressanta forskningsområden, men här bör det särskilt poängteras att nyttan uppkommer först då forskningen kommer fram till mottagaren.

Samarbeten i olika former mellan intressenter i näringen och forskare på olika lärosäten är en viktig komponent för att nå framgång på forskningsområdet. Följande forskningsenheter och projekt är goda exempel på framgångsrika områden inom funktionell kvalitet:

- Enheten för genetik och avel inom animalieproduktionen
- Enheten för husdjurshygien och – välfärd.

- Projektet ”Welfare Quality”- ett EU-projekt med syfte att utveckla kriterier för bedömning av djurens välfärd. SLU står här som koordinatör för projektet på grund av sin höga kompetens inom djurens välfärd.
- Partnerskap Alnarp
- Rehabiliteringsträdgård Alnarp
- FältForsk har formats för att utgöra en mötesplats mellan produktionsinriktad forskning och intressenter/näringen. SLUs forskare har här en unik möjlighet att fånga relevanta frågeställningar för forskningsbehov.
- Plant Com Mistra utgör också ett bra forum för samarbete mellan forskare på olika lärosäten såsom Södertörns Högskola och SLU och har genererat värdefulla forskningsresultat.
- MeNY:s olika utbildningsprogram som riktar sig till SME:s är exempel på innovativ och effektiv kunskapsförmedling. Enstaka SLU-forskare har medverkat i framtagning av kursmaterial men SLUs engagemang i Meny har varit relativt begränsat.
- SLU i samarbete med näringen, till exempel Jordbruksverket eller handeln.

Förbättringspotentialer:

- SLUs forskare bör bli bättre på att fånga upp relevanta frågeställningar och problem genom olika typer av mötesplatser. Centrumbildningarna – exempelvis CUL och CBM - är bra former för kontakt och samarbete med intressenter i omvärlden. Ett problem i sammanhanget är att nyttan av dessa enheter, som inte bedriver egen forskning inte värderas korrekt inom SLU. Under rubriken ”övriga kommentarer” tar vi upp detta.
- Mat 21 var ett omfattande och uppmärksammat forskningsprogram, med ambition att täcka hela livsmedelskedjan. Tyvärr levde det dock inte helt upp till de höga förväntningarna. Positivt var att projektet genererade många nya doktorer (om än dyra?). Satsningen ledde till många – var för sig – intressanta och framgångsrika forskningsprojekt men det skapades inte en helhetsbild, som kunde förmedlas till omvärlden och få effekt på olika aktörers verksamheter.
- SLU och dess forskare bör bli mer utåtriktade och bidra med objektiva synpunkter när olika mer eller mindre kontroversiella ämnen kommer till offentlig debatt. Forskare anses ha ingående kunskaper såväl som objektivitet i de ämnen som diskuteras. De anlitas därför mycket ofta av media. Inom sina verksamhetsområden har SLU här en utomordentlig viktig roll att spela. Varje dag debatteras frågor som rör de areella näringarna. Det görs idag bra saker på detta område inom SLU, alltifrån enskilda forskares engagemang till konferenser och faktablad. Men en betydande förbättringspotential finns här. Vi anser att SLU bör se över denna del av ”den tredje uppgiften” och förbättra denna. Exempel på åtgärder är att uppmuntra forskare att delta i debatter, mediaträning, effektivare kunskapsförmedling via faktablad på internet etc.
- Vidare bör SLU ha en kommunikationsstrategi för att informera om forskningen. Till exempel borde forskare tränas i att kommunicera med massmedier och därmed på ett enkelt sätt informera om sin forskning. Det kan också bli nödvändigt för SLU att utnyttja kompetens hos

kommunikationskonsulter för att kunna arrangera hearings, workshops och seminarier med populära inslag som även vänder sig till allmänheten med populära inslag. Ett exempel på publika arrangemang med presentation av SLUs forskningsområden är de så kallade Stenhammardagarna, som resulterade i att SLU-forskning fick stor uppmärksamhet i media.

- Vi rekommenderar därför att SLU ska säkerställa resurser för att hantera den externa kommunikationen. Genom att öka kontaktytan och relationerna med näring och intressenter och samhälle ökar därmed nyttan av SLUs verksamhet. Ansvaret för den externa kommunikationen bör vara tydligt organiserat med befogenhet både för övergripande ledning och fakulteterna både för att stimulera kommunikationen in till SLU och informationen och diskussionen ut mot näringen och samhälle.
- Ett akut problem för näringen idag är att man inte alltid känner till SLUs kompetensområden och att man inte vet var resurspersoner befinner sig eller om de existerar. SLU måste presentera sig tydligare för sina intressenter. Därmed underlättar man för dessa att kontakta SLU och initiera nya forskningsprojekt.
- Vi anser att utbildningen till livsmedelsagronom som i stor utsträckning vilar på pågående och tidigare forskning vid SLU är en mycket bra utbildning (och ett exempel på ovanstående). Dessvärre har SLU inte lyckats uppmärksamma livsmedelsindustrin på hur mycket dessa agronomer har tillföra den och därigenom även missat att synliggöra nyttan av SLU-forskningen.
- En möjlighet kan vara att utveckla så kallade "focal points" för olika områden för att underlätta kommunikationen med utomstående aktörer. Dessa kan utgöras av centrumbildningar såsom Partnerskap Alnarp eller CUL. De kan också bestå av en person eller grupp inom en institution, fakultet eller en annan organisatorisk enhet. Dessa kontaktpunkter skall marknadsföras.
- "LivsmedelsSverige" samt "Uppsala livsmedelscentrum" är huvudsakligen hemsidor. De har emellertid en stor potential att vara kontaktytor gentemot omvärlden med uppslag till nyheter samt kunskapsförmedling. Skall potentialen förverkligas krävs emellertid ett större engagemang från SLU inte minst gäller detta tilldelade medel för verksamheten.

Sammanfattningsvis kan vi konstatera att **hur** är avgörande för om **vad**, det vill säga den producerade forskningen, kan anses vara bra. **Hur** i sin tur ger även SLU dess image. Hur man presenterar sin forskning är därför en stor framtida utmaning och SLU bör ta fram en strategi för hur man gör forskningsresultat tillgängliga.

B 3. SLU:s image

Vi anser att SLU ska bibehålla och med stolthet stå för namnet Sveriges Lantbruksuniversitet. Lantbruket är en vital del av det moderna samhället och viktigt för utvecklingen av det hållbara samhället.

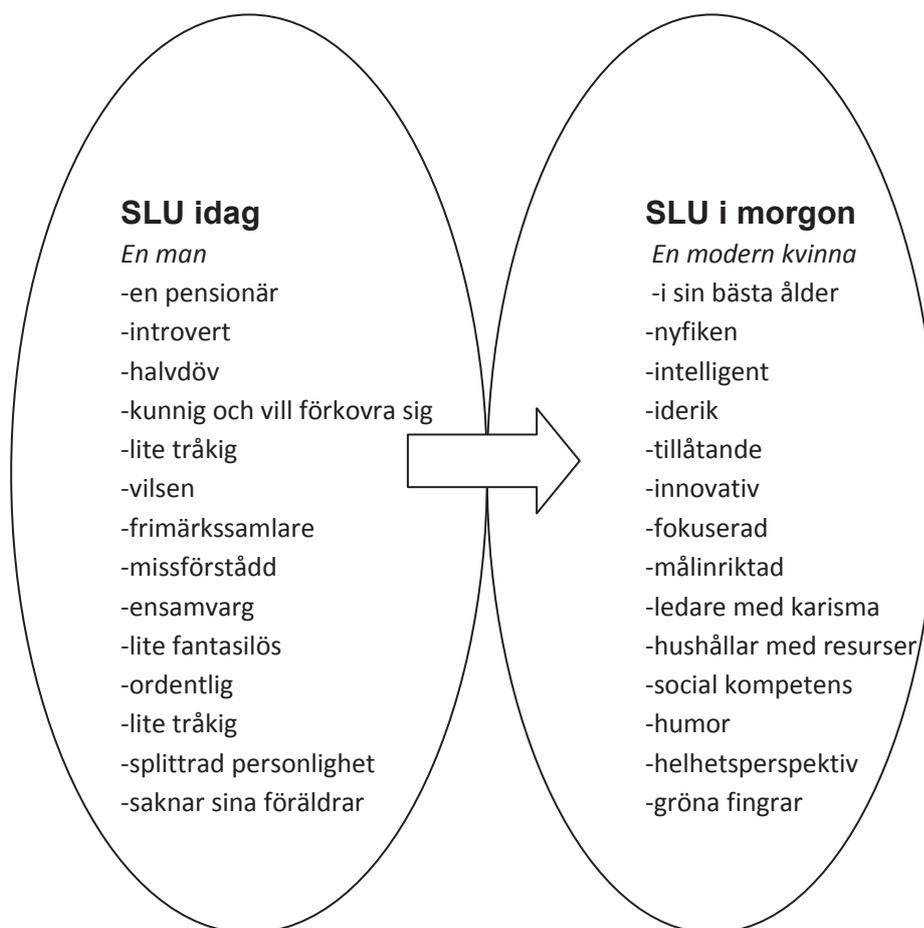
Enligt vår bedömning uppfattas SLU:

- Av andra universitet som ett bra universitet med goda finansieringsmöjligheter och resurser.
- Av primärproducenter som ett lantbruksuniversitet, som håller på med annat än jordbruk. Enligt vår bedömning gäller inte motsvarande uppfattning på skogsområdet.
- Av allmänheten som ett universitet med stort miljöengagemang.

Vidare bedömer vi att SLU:s geografiskt spridda lokalisering ger en styrka genom den lokala närvaron men kan å andra sidan försvåra byggandet av en gemensam image.

Vi noterar emellertid att man inom SLU fortfarande efter trettio år, diskuterar om ekologisk produktion har något berättigande. Det vore oss främmande att lägga oss i den debatten, men vi konstaterar att den knappast förbättrar SLU:s image.

I syfte att beskriva hur SLU uppfattas idag och hur vi vill att SLU skall uppfattas i morgon genomförde gruppen en övning där SLU beskrevs som en person. Vi kom fram till följande personifiering av SLU idag och imorgon:



B 4. Framtida utmaningar

SLU:s kärnfrågor är i fokus för samhällsdebatten, till exempel klimatförändring, bioenergi, livsmedelsförsörjning, men inte SLU. För SLU är den största utmaningen nu att placera sig i centrum, med forskning och utbildningar, som möter samhällets behov.

- SLU vill enligt sin vision vara världsledande inom life science området, men man kan inte vara världsledande på allt. En utmaning är därför att göra strategiska prioriteringar inom området life science.
- SLU måste identifiera dels områden där man idag har en styrka och dels områden där det finns luckor, som inte kan fyllas av någon annan aktör.
- Satsningar på ”centers of excellence” och satsningar på ”Future Agriculture” och ”Future Forests” är bra men inte tillräckliga.
- En framtida utmaning är att reda ut hur SLUs arbete med livsmedelskedjan ska organiseras.
- Inom de områden där SLU anser sig kunna bli världsledande måste man vara uthålliga.
- SLU måste dock utöver ambitionen att bli världsledande inom vissa specificerade områden också erbjuda forskning och utbildningar, som möter behoven i Sverige. Vi har konstaterat att SLU:s inriktning på jordbruksproduktion försvagats. Utbildning saknas inom till exempel agroteknik och ekologisk produktion.
- Forskning och utbildning inom agroteknik är av avgörande betydelse för de gröna näringarnas framtid.
- Man bör fokusera på att göra landskapsarkitektutbildningen bättre för därigenom eliminera potentiell konkurrens från andra universitet.
- En ökad satsning på produktionsforskning bör göras på SLU, främst inom området växtodling.
- Ett holistiskt synsätt krävs i flera avseenden. Forskning och utbildning måste bedrivas på systemnivåer – exempelvis gården, som ett system där livsmedel och energi produceras parallellt. Forskning och utbildning kring livsmedel kräver att hela livsmedelskedjan beaktas. En konsekvens av att SLU bedriver forskning och utbildningar i ett holistiskt perspektiv blir att organisationen inom universitetet måste förändras.
- Fakultets- och institutionsgränser måste överskridas. Den vetenskapliga utvärderingen visar att många forskargrupper är mycket små och därmed saknas förutsättningar för uthållighet, effektivitet och nyttiggörande av resultaten. För att och genomföra sådana förändringar och därmed åstadkomma strategiska prioriteringar för framtiden krävs ett starkt ledarskap på alla nivåer. Detta framgår också av den vetenskapliga utvärderingen.
- Ett helhetsperspektiv på livsmedelskedjan är nödvändigt och det är önskvärt att SLU tar ansvar för denna helhet, vilket inte utesluter att delar av forskningen utförs av andra. SLU

måste identifiera potentiella samarbetspartners inom andra lärosäten och relevanta kontaktnät ska skapas för att säkerställa kontinuitet i forskningen

- En utmaning för SLU är att bli tydligare och mer synligt i samhällsdebatten. Såväl den interna, som den externa kommunikationen måste utvecklas.
- Genom ett starkt ledarskap, fokusering på strategiskt viktiga områden, ett holistiskt arbetssätt samt förbättrad extern och intern kommunikation kommer SLU att öka sin attraktionskraft hos forskare och hos dem som söker utbildningar.
- Riskanalytiska principer utgör idag grunden för den internationella livsmedelslagstiftningen. Beslut om riskhanteringsåtgärder fattas alltmer utgående från riskvärderingar och betydelsen av effektiv riskkommunikation blir mer och mer uppenbar. Vi rekommenderar SLU att identifiera samtliga dessa tre riskanalytiska grundpelare som prioriterade forskningsområden.

C. Övriga synpunkter

Vi instämmer med de synpunkter som har kommit fram i intervjuer och i den vetenskapliga utvärderingen av SLU, med ett undantag. UoA och andra grupperingar som ej bedriver direkt forskning kan ej värderas enligt samma mall som forskande enheter. Här krävs det ett utvecklande av ett eget meritvärderingssystem.

Även om gruppen inte anser sig ha kompetens inom vattenfrågor, så anses det angeläget att forskning initieras på SLU inom detta område.

Rapport från intressentpanel

II. Djurhälsa och djurvälstånd

A. Sammanfattande bedömning för området

Starka sidor (inifrån)

- Gott renommé, trovärdighet och objektivitet
- Kvalitetssäkrad forskning
- Stor ämnesmässig bredd med stora resurser
- Forskningsresultaten kommer snabbt till praktiskt användning
- Sektorsuniversitet med nära koppling till användarna
- Utbildningen hålls aktuell med nya forskningsresultat
- Utbildningar med praktiska inslag i motsats till en del andra länders utbildningar

Svaga sidor (inifrån)

- Ledarskapet otydligt på många nivåer
- Ojämn intern struktur med dålig samordning och suboptimeringar
- Många geografiska lokaliseringar
- Bristande samarbete över institutions- och fakultetsgränser
- Dåligt genomslag av kommunikationsstrategi (om den finns)
 - föra ut forskningsresultaten till användarna
 - synliggöra SLU
- Ojämn forskningskvalitet
- Dålig planering för succession för viktiga befattningar
- Namnproblematiken (SLU)
- Gubbvälde i karriärtoppen men mest tjejer bland studenterna

Möjligheter (utifrån)

- Forskningsbehovet ökar
- Nya finansieringskällor (EU, näringen...)
- Nya forskningsområden t.ex. människa – djurrelationen, djur – miljö/klimat
- Attraktiva arbetsområden
- Ökande informations-/kunskapsbehov från allmänheten i djurrelaterade frågor
- Många potentiella samarbetspartners
- Nya lokalerna

Hot (utifrån)

- Besparingskrav
- Konkurrens om forskningspengar med andra universitet
- Alltmer kortsiktig finansiering kan minska andelen grundforskning
- Forskningspolitiska beslut som styr bort från djurområdet
- Kompetensflykt

Rekommendationer

1. Lyft fram djurperspektivet i SLU:s övergripande strategidokument
2. Ledarskap
 - rekrytering utifrån ledaregenskaper
 - ledarskapsutbildning
 - få ordning på organisation och beslutsstruktur
 - ta fram och få genomslag för en strategiplan
 - vad ska vi forska på/vara bra på
 - finansiering
 - partners
 - personalrekrytering/succession
3. Ta fram och genomför en kommunikationsstrategi
 - föra ut forskningsresultaten populärvetenskapligt och på annat sätt (meriteringsgrundande?)
 - synliggöra SLU
4. Skapa nya forskarstrukturer
 - utrymme för bra strategiskt ledarskap
 - utrymme för administrativt stöd
 - tillräcklig kritisk massa
 - ta bort dubbelarbete (samma forskning på flera ställen)
 - kontinuerlig omvärldsanalys
 - strategi för långsiktig forskningsfinansiering

B 1. Teknisk kvalitet och relevans

Generellt sett anser gruppen att SLU i princip gör rätt saker. Forskningen ger god nytta vilket gäller såväl den forskning som beställs direkt av intressenter som den forskning som bedrivs på SLU:s eget initiativ. En viktig sak som levereras av SLU är de studenter och disputerade som utexamineras och som ger en god rekryteringsbas för intressenternas organisationer. Utbildningarna uppfattas hålla hög kvalitet och studenterna från SLU har en hög anställningsbarhet. Detta är en viktig resurs som SLU levererar och som efterfrågas konstant. Från demokratisynpunkt kan dock genusperspektivet vara ett problem eftersom den övervägande majoriteten av studenterna inom djurområdet är kvinnor. Fortfarande är emellertid de flesta professorer män. Det bör också påpekas att en allt större andel av antalet veterinärer som legitimeras i Sverige har fått sin utbildning på andra universitet i Europa.

Inom forskningen följer här ett antal exempel där intressenterna finner att SLU gör god nytta och exempel där det fungerat mindre bra.

Inom djurskyddsområdet förekommer en del uppdragsforskning som beställs av Jordbruksdepartementet via Statens Jordbruksverk (SJV). Där gör SLU rätt saker och levererar det som efterfrågas. Vid mer direkta behov av kunskap kring ett specifikt område fungerar det bra att via direktkontakt få svar på frågor från forskare på SLU. När EU skulle förändra sin fjäderfälagstiftning bidrog forskningen från SLU väldigt mycket eftersom forskningen inom detta område låg långt framme på SLU. Ett exempel på problem inom djurskydd är efterfrågad forskning på bedövning i samband med kastrering av ren, vilket man inte har lyckats hitta någon som är villig att ta på sig. Kunskap kring minkhållning och minkens naturliga beteende har visserligen efterfrågats, men det ifrågasätts inte att denna typ av forskning saknas på SLU.

För forskningen inom lantbrukets husdjur finns en god beställarkompetens i näringen. Forskningen inom djurhälsa används ofta direkt för att bygga upp praktiska tillämpningar och man har en god kontakt mellan intressenter och forskare på SLU där man exempelvis deltar på varandras seminarier etc. Ett område inom djurhälsa där SLU inte är lika proaktivt som inom andra områden är forskning inom EHEC/VTEC och forskningen inom detta område bör förstärkas. SLU:s forskning på smittskydd och smittsamma sjukdomar inom mjölkproduktionen upplevs som bra och forskningen har varit ute i god tid och haft ett bra samarbete med näringen. Detta gäller även för forskning inom mjölkkoavel där forskning och näring har gått hand i hand under flera årtionden för att få en god djurhälsa och djurvälstånd. Ett område som inte forskas på i den utsträckning branschen önskar är sjukdomspanorama och smittskydd i växande besättningar inom mjölkproduktionen. Även forskning kring management i större besättningar efterfrågas eftersom detta är mer komplext och kräver ett större helhetsgrepp än den forskning som generellt bedrivs inom mjölkproduktionsområdet.

Inom hästforskning upplevs det att SLU oftast har forskat på rätt saker och att forskningen har varit relevant. De exempel som lyfts fram är forskning i internationell framkant rörande inflammationsmarkörer vid ledbesvär hos häst. Ett annat område är allergiforskning där forskare från SLU har deltagit tillsammans med forskare från andra universitet vilket har varit ett gott tvärvetenskapligt projekt som har gett direkta konsekvenser för myndighetsbeslut. En utredning om hästnäringens ekonomiska betydelse har också gett en mycket god nytta i näringen och varit användbar i en rad olika sammanhang. Ytterligare ett exempel är biomekanikforskningen, där pågående forskning om bl.a. hästens rörelser och banunderlag har rönt stort intresse inom hästsporten såväl nationellt som internationellt. Ett problem inom hästforskningen är att den kliniska forskningen har blivit eftersatt vid SLU och de kliniska försök som startats har ofta inte blivit genomförda eller dragit ut på tiden eftersom patientunderlaget inte har räckt till. Idag uppfyller inte SLU heller de önskemål om vad som behövs i form av försökshäststall men det är en förhoppning att detta åtgärdas när nya lokaler uppförs. SLU har en gång varit världsledande inom träningsfysiologi på häst men på grund av bland annat generationsskifte finns denna forskning nästan inte alls kvar vilket ställer frågor kring ledarskapet på SLU och hur man hanterar generationsskiften och pensionsavgångar. Det ifrågasätts också varför hästforskning inte verkar ingå i SLU:s satsning inom Centrum för djurvälstånd. Inom området häst är det idag inte heller lika självklart att SLU är den part man vänder sig till gällande specifika kliniska problem.

SLU ger ofta det vetenskapliga stöd som behövs inom smådjursområdet och kan ge en plattform för internationell utblick. Forskningen inom smådjursmedicin är viktig, liksom forskning inom molekylär husdjursgenetik vilket är ett område som växer explosionsartat. Framgången för molekylär husdjursgenetik inom hundområdet är ett exempel där SLU:s strategiska satsningar genererat ytterligare stora internationella medel samt stor nytta för intressenterna. SLU ger idag inget komplett stöd för smådjursnäringen utan man får ofta vända sig till olika regiondjursjukhus i Sverige eller universitet och institutioner i övriga Norden, Europa och Nordamerika och man vänder sig allt oftare till andra institutioner än SLU. De ekonomiska ramarna inom smådjursområdet är även ganska små och för utlysta medel inkommer oftast ansökningar på två till tre gånger större medel än vad som utlysts. Ytterligare problem inom smådjursområdet är att branschen upplever att sällskapsdjursforskning är under en alltmer ökande konkurrens och att personalflykt från SLU förvärrar dessa problem för smådjursforskningen. Framstående medarbetare på SLU försvinner ofta till andra djursjukhus eller till andra länder. Ett särskilt område som saknas på SLU är relationen människa – djur. Denna typ av forskning saknas helt i Sverige och SLU skulle kunna vara en viktig part i denna typ av forskning i framtiden. Kattforskning saknas också i mångt och mycket och idag är anslagen inom denna forskning små men det kan vara en nisch som kan vara viktig i framtiden och om inte SLU tar hand om denna forskning så kommer den att bedrivas på andra platser. Smådjursbranschen är under stark tillväxt och antalet professionella ökar stadigt inom detta område som tidigare enbart varit hobbybetonat. Detta borde ge en ökad efterfrågan av högskoleutbildning inom detta område, främst i form av enstaka kurser på högskolenivå.

B 2. Funktionell kvalitet

SLU:s funktionella kvalitet upplevs olika beroende på vilken beställar- och mottagarkompetens som finns i näringen. Exempelvis är mottagarkompetens större inom myndigheter och företag och organisationer som jobbar med lantbrukets djur än den är inom områdena häst och smådjur. Dessutom finns det en variation bland avnämarna i hur nyttan ska paketeras för att tas emot på ett bra sätt. Det betonas också starkt att SLU:s strategi för att kommunicera med intressenter och allmänhet måste utvecklas betydligt. Ett viktigt förslag för att förbättra kommunikationen till intressenter är att SLU inför någon slags arena där näring och forskare kan mötas kontinuerligt, exempelvis i samma form som de projektråd som SVA har och som träffas en gång per år.

Nedan följer exempel på när den funktionella kvaliteten har varit bra och exempel på när det fungerat mindre bra.

Ur myndighetssynpunkt vill man ha fram resultat och en populärvetenskaplig sammanfattning av beställda projekt vilket fungerar bra och man upplever att man har bra samarbeten med SLU. När man efterfrågar forskning får man också många ansökningar. I arbetet med fjäderfälagstiftningen i EU var SLU väldigt aktiva och man hade nära kontakt med myndigheterna vilket gjorde att goda exempel från svensk forskning fick stor spridning. En uppskattad kontaktyta är att vara med i betygsnämnder vid disputationer och seminarier i samband med disputationer. Mindre konferenser där SLU varit med har även det varit bra forum för kontakter med SLU. Det som saknas är dock mer regelbunden information från SLU, t.ex. regelbundna nyhetsbrev och fler mötesplatser med SLU. De informationsblad som trots allt kommer från SLU har en bra effekt. Det efterfrågas också att SLU:s hemsida bör få en bättre sökfunktion så att man snabbt kan få fram aktuella forskningsresultat.

För organisationerna som jobbar med lantbrukets djur har man – förutom en god beställarkompetens – även en god mottagarkompetens och därmed kunskap att ta hand om en forskningsrapport och göra om denna till ett tillämpat program. Kontaktvägarna är också korta och det är lätt att kontakta berörda forskare. Dessa organisationer tar dock själva ansvaret för att nyttan från SLU kommer fler till del genom att kommunicera forskningsresultat från SLU till veterinärer, rådgivare och lantbrukare genom att hålla konferenser, ordna utbildningar och publicering i egna tidningar. När man efterfrågar information ställer forskarna dock alltid upp. Man prioriterar ofta kontakten med SLU och att komma till seminarier och övningar som denna och det är också positivt att personer från SLU kommer till näringens arrangemang. Det efterfrågas dock fler arbetsmöten, t.ex. som SVA:s projektråd. Kommunikation av nytta från SLU beror också på hur aktiva avnämarna är men man undrar hur andra får tag i den information som efterfrågas. SLU behöver stärka sin strategi i att kommunicera forskningsresultat betydligt.

Inom hästsektorn har kommunikationen förbättrats betydligt på senare år och SLU är numer mer öppet för externa impulser inom denna sektor. Det är dock värt att poängtera att det är först på

senare tid som kommunikationen med SLU har fungerat bra. Under 2008 genomförde man tillsammans med hästnäringen forsknings- och utbildningsforum på fyra olika platser i Sverige då man hade både information om forskningsprojekt och dialogpass vilket var mycket lyckat. SLF:s projekt LOFT har även det lett till en förbättrad dialog mellan SLU och häst/landbrukssektorn. Det finns fler goda exempel såsom Hippocampus, med månatliga informationsmöten för intressenter och årliga sammankomster (Hippocampusdagarna), samt Hästcentrum Skara. Man för dessutom diskussioner om att starta ett projekt liknande Livsmedelssverige.org där även näringen kommer att finnas med. Hippologutbildningen vid SLU är en viktig källa till uppslag för tillämpade forskningsområden. Inom området hästhälsa ifrågasätts det hur mycket egna initiativ SLU tar och hur man för in kliniskt material från djursjukhusen runt om i landet in i forskningen. Positiva exempel på detta finns dock, även om det kunde ha haft en större omfattning, bl.a. finns det exempel på projekt där man samlat in klinikfynd från hela Sverige.

Inom smådjursområdet startades för ett antal år sedan Kompetenscentrum smådjur vid SLU. Från näringens sida såg man detta som en mycket bra idé och det var synd att denna ambitiösa satsning föll, troligen pga. ledningsproblematik, intern konkurrens och motstånd. Idag används istället en del av medlen som skulle gått till forskning av intressenterna själva till att göra populärvetenskap av forskningsrapporter med hjälp av inhyrda journalister. Goda exempel är Institutionen för Husdjursgenetik som gör regelbundna e-brev vilket då är kopplat till en forskargrupp där det händer mycket. Dessutom genomförs det av SLU löpande seminarier inom smådjursområdet vilka är positiva och välbesökta och det är viktigt att dessa fortsätter. Detta medför en naturlig plats för SLU att skapa mervärde. Det finns också ett projektråd inom smådjursområdet då man scannar av och rapporterar pågående projekt vilket tar tag i frågor på bredden.

Generellt för SLU bör det skapas incitament för att belöna populärvetenskaplig publicering i högre grad och det bör finnas ett internt belöningssystem för detta. Ibland upplevs det dock som ett problem att kunskap inte kan spridas förrän den blivit vetenskapligt publicerad. Vidare är värdskap för nationella och internationella kongresser en viktig uppgift för SLU, både för sakfrågorna men även för symbolvärdet. En särskild uppgift för SLU är att hålla koll på och kunna kommunicera nya kunskapsfält som näringen har begränsad information om. Detta är en unik uppgift som intressenter har svårt att klara men som SLU bör ta ansvar för, SLU måste ha spaningskompetens.

Det är en viktig ledarskapsfråga att man gör en "affärsplan" för att planera varje del av verksamheten med långt tidsperspektiv. Därmed skulle SLU bättre klara ut vad som händer när personal går i pension eller slutar av andra skäl, frågor som successionsordning och vilka man behöver rekrytera för att inte SLU ska tappa strategiska forskningsområden är mycket viktiga. Viss spetsforskning är mycket personbunden vilket kan leda till att viktiga forskningsfält försvinner när specialister lämnar SLU och det upplevs som att SLU:s ledning inte tar tag i detta problem. SLU kan dock inte forska på allt och vissa områden måste få bli starkare än andra. Somliga områden får överlämnas till företrädesvis andra nordiska universitet.

Generellt sett upplevs det som irriterande när overheadpåslag i forskningsansökningar varierar mycket inom och mellan institutioner vilket måste vara något slags systemfel och som ger en mycket spretig bild av SLU mot forskningsråd etc. Intressenterna kommer också bli mer strikta gällande ej levererad forskning som man har beställt och det är viktigt att SLU tar med sig detta eftersom det pekar mot att det kan finnas effektivitetsproblem internt inom SLU.

B 3. SLU:s image

I vår sfär har SLU ett högt anseende och anses vara opartiskt, sakligt och pålitligt. SLU behövs framförallt för objektivitet och för att få fram forskning som man litar på, forskning från SLU har också en kvalitetsstämpel. Samhällsansvaret kunde dock ha haft en starkare roll och i synlighet lämnar SLU mycket övrigt att önska. Panelen frågar sig dock hur synliga andra svenska universitet är och hur mycket allmänheten måste veta vad SLU är. Vad betyder SLU, namnet SLU är inte alltid användbart externt och även internt är det ett problem och bland SLU:s personal används fortfarande ibland exempelvis "Veterinärhögskolan". Detta kan uppfattas som att SLU har problem med sin identitet.

Det är ett mervärde att SLU är ett agrart universitet och ett sektorsuniversitet. Även bredden och möjligheterna till tvärvetenskap har stora mervärden. Det är också ett mervärde att de områden som idag finns på SLU inte är utspridda på flera andra universitet. Synlighet och kommunikation är dock viktigt för att få ut resultat från forskningen vid SLU. Kliniskt kunde SLU varit starkare och där har man tappat sin ledande roll. SLU måste agera för att förändra den kliniska utbildningen och forskningen eftersom SLU:s anseende på det kliniska området har gått ner. Även bristen på koppling mellan veterinärmedicin och humanmedicin upplevs som en svaghet ute i näringen. Veterinärerna som kommer ut från SLU har en hög teoretisk kvalitet. Det är viktigt att slå vakt om den praktiska utbildningen för veterinärer och idag är nivån tyvärr lägre än den varit förut, tidigare har SLU-utbildade veterinärer ansetts ha en god klinisk kunskap. Den praktiska erfarenheten har även blivit lägre hos utexaminerade husdjursagronomer och man bör fundera på något slags "internship".

Djuren, djurhälsa och djurvälstånd måste också få ett egenvärde i SLU:s strategi och inte enbart ges den komparativa roll som de idag har i strategin. Det är trots allt en stor andel av studenterna som examineras från SLU årligen som har en djuranknytning, t.ex. veterinärer, djursjukskötare, hippologer och husdjursagronomer. Dessa yrkesutbildningar, tillsammans med andra, är också en viktig orsak till att SLU finns. Mycket av forskningen vid SLU skulle kunna genomföras på andra ställen men utbildningarna vid SLU är oftast helt unika i landet.

SLU måste skaffa sig en mer uttalad kommunikationsstrategi och man måste bygga en kultur i hur

man kommunicerar. Detta blev tydligt i den aktuella debatten kring dansk svinproduktion och där SLU-forskare gav väldigt åtskiljda bilder av hur situationen ser ut i Sverige och vad man valde att lyfta fram. Här skiljer sig också näringens uppfattning för hur en specifik forskargrupp kommunicerar jämfört med den vetenskapliga panelens bedömning där de gav bra vitsord för förhållandet med näringen och detta är inte så som näringen upplever hur denna forskargrupp kommunicerar. När konsulentavdelningen fanns, var det mer självklart vilka som uttalade sig om olika frågor för SLU:s del, medan det i dagsläget ger ett mer splittrat intryck. Många myndigheter i Sverige har en uttalad kommunikationsstrategi och det är viktigt att SLU också skaffar sig en. Vem säger vad och vad säger vi?

Centrum för djurvälstånd är ett exempel där SLU ännu inte har lyckats i sin kommunikation och intressenterna vill höra mer om detta, hittills har informationen varit trevande och oklar. Detta centrum skulle kunna bli en viktig pusselbit för att kommunicera mer om frågorna kring djurvälstånd.

Nuvarande ledning på SLU har börjat förändra bilden av SLU. Förut var SLU de grå eminensernas universitet. SLU är trovärdigt och opartiskt och har många experter men dessa har ojämn kvalitet och det finns få profiler som syns. Förhållningsätten och incitamenten för att få ut forskningsresultat i näringen måste förstärkas och SLU måste ta egna steg på denna väg. Slutligen bör det dock påpekas att SLU har ett gott renommé.

B 4. Framtida utmaningar

- SLU bör överväga hur en lämplig bredd i djurforskningen ska upprätthållas, särskilt som sport- och sällskapsdjur är en sektor som växer. Detta gäller inte bara veterinärmedicin utan även miljö, skötsel, utfodring och djurvälstånd etc.
- SLU behöver kommunicera bättre och man behöver utveckla sin image för att få fler intressenter. SLU bör också ta en naturlig plats i samhällsdebatten.
- Kommunikationsstrategin behöver ses över och kompletteras med en ökad omvärldsbevakning och omvärldsanalys.
- Viktigt att ha god kontakt med intressenter för fortsatta fruktbara samarbeten men SLU måste också ha en egen tydlig strategi som kan fånga upp intressenternas önskemål.
- SLU måste säkra upp att alla forskningsresultat når sina målgrupper, även för områden där intressenterna själva inte har möjlighet att ta ansvar för detta. SLU måste bestämma sig för vilka kompetensområden man ska ha, det går inte ha hela bredden och samtidigt djup inom alla områden.
- Ledarskapsfrågor och intern samverkan måste utvecklas på SLU. Utveckling av ledarskap och beslutsprocesser bör prioriteras. Successionen för viktiga befattningar måste säkras och man måste skapa möjligheter för nydisputerade forskare.

Forskningsområden, som bör stärkas:

- Relationen djur – människa.
- Management i allt större mjölkbesättningar . Hälsfrågorna, särskilt smittskydd, behöver här fokus.
- Cost-benefit analys av behandlingsmetoder. Hälsoekonomi. Behöver hitta de ekonomiskt optimala behandlingsmetoderna inom många områden.
- Kattforskning har möjlighet att utvecklas.
- SLU behöver vara en part i den unika nordiska synen på djur och allergi vilket bör göras tillsammans med humanmedicin. Många andra delar av världen upplever inte detta problem.

C. Övriga synpunkter

Kopplingen forskning – undervisning

Det sjukdomsförebyggande arbetet blir allt viktigare för lantbrukets djur. Behovet ökar mest inom mjölkproduktionen, där besättningsstorleken kraftigt växer. SLU genomför bra forskning i relevanta områden, men lyckas inte omsätta dessa kunskaper om besättningshälsa och förebyggande arbete i veterinärundervisningen. Detta leder till en ökande brist på kompetenta veterinärer i landet. SLU bör sätta hög prioritet på att förbättra undervisningen i detta avseende.

Balansen grundforskning – tillämpad forskning

Externa forskningsfinansiärer är viktiga, inte minst eftersom de tillför tydliga beställningar utifrån ett behov bland avnämarna. För att få ut den fulla potentialen av tillämpad forskning med extern finansiering krävs emellertid en mycket stabil bas, där SLU:s långsiktiga forskningsområden med statlig finansiering definieras. Vi uppfattar ett tydligt behov av att fram strategier och säkra en basfinansiering för detta.

Remisskommunikation

Under presentationen av utvärderingen framkom att remisser från myndigheter till SLU ibland skickas till enskilda institutioner/forskare. Det är viktigt att remissen går till SLU centralt och att det är SLU:s synpunkt som myndighet som uttrycks i remissyttrandet. Enskilda forskare är naturligtvis välkomna att svara på remisser men det ska då framgå att det är den enskildes synpunkt som uttrycks i svaret. Det har förekommit att enskilda forskare svarar på remisser (förutom att det kommit in svar från SLU centralt) och då använt sig av SLU:s brevpapper. Detta kan skapa förvirring när remissyttrandena ska bearbetas. Det är därför viktigt att SLU centralt tar ansvar för vem som svarar på remisser och hur dessa utformas.

Rapport från intressentpanel

III. Energi- och industriråvaror

A. Sammanfattande bedömning för området

Rekommendationer och förslag

- Vårda och utveckla rollen som sektorsuniversitet. Fokusera på de strategiska forskningsområdena (se B4).
- Utveckla och rekrytera starka ledare inom forskningen .
- Samverka (internt och externt) för att nyttja befintliga resurser.
- Stärk och tydliggör SLUs image.

Styrkor

- **SLUs verksamhetsidé** ("SLUs verksamhetsidé är att utveckla kunskapen om de biologiska naturresurserna och människans hållbara nyttjande av dessa").
- Att SLU kan anlägga ett **systemperspektiv** och ta ett **helhetsgrepp** utifrån djup kunskap inom kärnområdena.
- **Sektorsrollen**. Uppskattas av sektorn och upplevs (inte minst i och med KoN) som prioriterad även av SLU självt.
- **Samarbetsprojekt mellan näringen och forskargrupper** som fungerar mycket bra.
- **Nätverk och informella samarbeten**.
- **Excellent forskning** finns inom SLU.

Svagheter

- **Imageproblem** för den gröna näringen som också gäller SLU. För mycket fokus på problem och för lite på lösningar.
- **Oklart förhållningssätt i vissa policyfrågor viktiga för samhället och näringen**.
- **Fragmentering** till följd av bristande intern samverkan inom samma ämnesområde samt att SLU försöker greppa över ett för stort antal områden.

- Många samarbeten och verksamheter som skapat nytta är starkt **personberoende** och därmed sårbara för förändringar och personalbyten.
- **Ojämn kvalitet i forskningen.**

Möjligheter

- Att förstärka **systemtänkandet** och helhetssynen på fler områden.
- Att **fokusera mer på lösningar och mindre på problem** gällande den gröna näringens frågor.
- Att **ta sig an aktuella samhällsproblem** som kan lösas av de gröna näringarna.
- Att **öka samarbetet och samordningen** inom SLU och att ena universitetet bakom en vision.

Hot

- Att **inte lyckas vända imagen för SLU.**
- **Oförmåga att genomföra nödvändiga förändringar.** Både de som kommer fram i KoN och mer generella förändringar som samhället påkallar.
- Att **attraktionskraften i utbildningarna sjunker ytterligare** inom områden som är viktiga för de gröna näringarna.

B 1. Teknisk kvalitet och relevans

Följande faktorer har av panelen identifierats som avgörande för forskning som varit bra ur ett nyttoperspektiv (utan inbördes rangordning).

- **Ledarskap.** Många av de forskningssamarbeten som fungerar bra har en stark och tydlig ledare i forskningsgruppen.
- **Interaktion under givna förutsättningar.** För att interaktionen ska fungera måste båda sidor ha respekt för varandra. Från intressenternas sida måste det finnas en förståelse för forskarens profession och kunnande och en öppenhet inför de svar man kan få. Om intressenten redan har bilden klar för sig eller vill få något snabbt utrett är det kanske en konsultbyrå och inte en forskare på SLU som ska engageras. Akademin måste själv också vara tydliga här på vad det är som erbjuds och vad intressenten kan förvänta sig.
- **Problem- eller visionsorienterad formulering av frågeställningar.** Att intressenterna finns med redan på problemformuleringsstadiet är avgörande för att få forskning med ett högt nyttoinnehåll. Att forskningen ska vara problemformulerad ska inte uppfattas som att den enbart ska syfta till att lösa kortsiktiga, välavgränsade problem (jmf resonemangen om konsulttjänster ovan) men den måste få utgå från vad intressenterna upplever som relevant. Relevanta frågor kan också handla om problem på längre sikt som man kan identifiera och som har ett mer visionärt innehåll.

- **Forskningsmetodiken.** Förmågan att formulera forskningshypoteser på ett sådant sätt att svaret kan användas som tillämpligt resultat. Upplägget ska vara sådant att ett tydligt slutresultat och svar kan utläsas och senare komma till användning.
- **Samarbeten mellan grupper.** Många frågor är komplexa och kräver att man tar ett systemperspektiv. Många frågor behandlas idag också av olika grupper vid SLU, grupper vid olika orter eller fakulteter och den interna samordningen är inte alltid den bästa.
- **Gemensam styrning.** Genom referens- eller styrgrupper där olika intressenter, forskare etc. är involverade säkerställs att alla intressen kan tas tillvara.

Exempel som lyfts fram som god nytta och som passar under flera av de ovan angivna rubrikerna är:

Inom skogliga området

- **Riksskogstaxeringen**, med **Hugin** och **Heureka** som är helt centralt för arbetet på nationell nivå med statistik och konsekvensanalys.
- **Fjärranalysen (skoglig resurshushållning)**, nära samarbete med externa intressenter i utvecklingsarbetet.
- **Sydsvensk skogsforskning** som startade som var ett gemensamt projekt för sydsvensk skogsnäring och SLU, som sedan övergått i Sydsvensk skogsvetenskap och följts av ytterligare gemensamma projekt.
- **Enheten för skoglig fältforskning**, med försöksparkerna som är ovärderliga för forskning och kunskapsförmedling.
- **Institutionen för skog-industri-marknad studier (Sims)** som arbetade nära skogsnäringen i angelägna frågor inom området.
- **Snytbaggeprogrammet** som startade som ett temaforskningsprogram och sedan följts av två program med finansiering från näringen och som gett ovärderlig kunskap för hantering av snytbaggeproblemet.
- **Genetikforskarskolan** som drivs gemensamt av SLU och skogsnäringen och som syftar till angelägen kompetensuppbyggnad inom området och söker länka samman kvantitativ och molekylär skogsgenetik.
- **Viltekologin** (Kjell Danell) har gett mycket värdefulla kunskaper för viltförvaltningen och inom området pågår ett intressant temaprogram ”Vilt och skog”.
- **Naturvårdsbiologi** (Lena Gustavsson) har bidragit med viktiga kunskaper och beslutsunderlag för effektivare naturhänsyn.
- **Mark- och vattensidan, såväl inom mark- som vattenforskningen** (Högberg, Kevin Bishop m.fl.) har grundläggande kunskap och forskningsresultat tillförts praktiken.
- **Skoglig mykologi och patologi** (Jan Stenlid) har tagit fram grundläggande kunskap för

hantering av rotröta i skogsbruket.

- **Centrum för biologisk mångfald och Artdatabanken.**

Inom bioenergiområdet

- **Bioenergi** (Per Anders Hansson m.fl.)
- **Entomologi** (Stig Larsson)
- **Bevattnings med avloppsvatten och lustgasmätningar** (Per Aronsson)
- **Micro Drive** (Johan Schnürer)
- **Teknisk rapsolja** (Sten Stymne)
- **Växtförädling på salix** (Sara von Arnold)

Områden som har gett liten nytta eller saknas är:

Inom skogliga området

- **Virkesförädling.** Att se större samband och hålla ihop kedjan. Kunskapen bland de nytutexaminerade varit bristfällig på detta område och ett samarbete med SLU har därför startats, men ännu har detta ingen vetenskaplig höjd.
- **Skogsgenetikens kvantitativa kompetens har utarmats under en längre tid.** Åtgärder har vidtagits i form av en forskarskola. Fortsatta åtgärder behövs för att stärka området.
- **Skogsteknikområdet** har länge varit tynande på SLU men under senaste åren har åtgärder påbörjats bl.a. i form av en gemensam forskarskola mellan Skogfors och SLU samt ett antal finska aktörer.
- **Skogsentomologin** har varit mycket viktig med anledning av senaste årens stormar i södra Sverige och har delvis funderat bra. SLU:s roll måste dock förtydligas och bli mer lösningsorienterad. Nu fastnar det mycket i att identifiera risker och problem.
- Synteser och samband mellan olika **åtgärder för miljöhänsyn** i skogen och dess effekter för biologisk mångfald och skogsproduktion.
- **Skogsskötselns forskning i norra Sverige**, i de tillämpade delarna, har halkat efter. Stora förändringar har gjorts med institutionssammanslagningar men ännu har inte resulterat av detta syntes.
- **Plantageskogsbruk** som sker i t.ex. Brasilien. Sverige har stor kunskap och borde på en global nivå kunna bistå och nyttja vår forskning till att svara på frågor som även rör förhållanden i dessa miljöer. Lämpliga samarbetspartners är t.ex. Sida och Skogsstyrelsen.

Inom bioenergiområdet

- Ett forum som man kan vända sig till i **bioenergi- respektive klimatfrågor**. Skulle kunna organiseras som en plattform eller en centrumbildning. Forskningen är idag splittrad mellan olika institutioner och fakulteter. Det skulle vara önskvärt att starta ett större strategiskt program (jmf Bränsleprogrammet som en start, det är fortfarande är splittrat) med flera intressenter och med SLU som bas.
- **Ekonomisk forskning**, makroekonomi och samhällsekonomi. Är i behov av en profil som sätter SLU på kartan och får igång tänkandet i näringen och inom den offentliga förvaltningen. Under ett antal år har ekonomiutbildningarna utarmats och detta börjar nu märkas av mer och mer. Satsningen på miljöekonomi är bristfällig då kopplingen mellan ekonomi, biologi och teknik har blivit alldeles för svag. Detta innebär att man inte är konkurrenskraftig med andra lärosäten.
- Inom **bioråvaror till kemisk- teknisk industri** finns behov av att skapa en plattform och SLU måste samarbeta med andra lärosäten. SLU har likväl fördelen att man har kopplingen till den grundläggande grödan och det borde vara en komparativ fördel.

Förutom forskning med resultat som bedöms som viktiga ur ett nyttoperspektiv finns det ett antal andra sätt på vilket SLUs verksamhet kommer intressenterna tillgodo. Detta är (utan inbördes rangordning):

- **SLU som rekryteringsbas**. Neringen rekryterar varje år så väl personer som genomgått utbildning på grund- och avancerad nivå som forskarutbildningsnivå på SLU till sin verksamhet.
- **Informella kontakter**. Att man ingår i samma nätverk, har samarbeten som inte är formaliserade och att det är lätt att lyfta luren och bolla tanka med någon forskare som man har ett pågående samarbete med.

B 2. Funktionell kvalitet

Paketeringen av forskningsresultat har generellt fungerat bra när intressenterna varit med och formulerat forskningen och projektet från början (jmf B1). Kommunikationsplaner för hur kunskapen ska publiceras och nyttiggöras bör tas fram redan när projekt sätts igång. Viktigt är också att projekt rapporteras löpande, t.ex. genom seminarier och att man får se rapporter som utkast.

Panelen har en generell fundering kring om inte mycket av det som diskuterats kanske är brister i paketeringen. Kan det vara så att vi inte vet om vilken forskning som sker och därför pekar ut dem som områden där SLU behöver satsa trots att universitetet faktiskt har en bra och relevant forskning redan idag?

Från näringsens sida finns det också anledning att vara självkritisk och fundera på mottagligheten för forskningsresultat eller t.ex. industridoktorander, som kan vara en mycket bra ingång till samarbeten och att få tillgång till både personer och kunskap på SLU. Därtill har intressenterna själva problem med att samla sig och t.ex. medverka i råd och programgrupper. Det är därför viktigt att inte bara

efterfråga en kommunikation som man sedan inte vet att man kan ta emot som intressent.

KTH:s samverksansplattformar verkar vara ett lovvärt initiativ även om ingen i panelen har några närmare egna erfarenheter.

Enskilda goda exempel och viktiga arenor:

- **Höstkonferenser** (medverkande från näringen, myndigheter och forskare).
- **Exkursioner** arrangerade av exempelvis Sydsvensk Skogsforskning och som är ett mycket konkret exempel på att kommunicera kunskap.
- **SLUs hemsida**, och speciellt vissa delar som Skogsskada.
- **Fakta Skog, BioDiverse** och **Miljötrender** är popularisering av forskningsresultat som upplevs fylla sin funktion relativt väl. (Publiceringen är sporadisk och av varierande kvalitet).
- **Samverkansprojekt**, t.ex. Framtidens skog, Tema tillväxt etc. är ju stora möjligheter till samverkan.
- **Nätverk**, och **informella kontakter** med enskilda forskare som kan bidra till kunskapsförmedling.
- **SKA08** (Skogliga konsekvensanalyser med avverkningsberäkningar baserade på rikstaxen) och andra uppdrag.
- **Heurekas årsrapport** är en bra publikation där de som inte är aktiva deltagare själva också kan få information.
- **Skogsskötelsen**
- **Deltagande i SLU-organ**. Neringen är företräd i styrelsen, fakultetsråd och som adjungerade i fakultetsnämnder. Det finns för- och nackdelar med både fakultetsråd och som adjungerad. SLU bör därtill överväga att införa tematiska samrådsgrupper.
- **Examensarbetskola** i samarbete mellan SLU och LRF inom klimatområdet.

Panelen diskuterar olika typer av konferenser och vad som gör en konferens framgångsrik, också om det finns olika konferenstraditioner inom olika sektorer. T.ex. uppges skogens höstkonferens fungera bra men motsvarande försök inom jordbruksområdet har inte gjort det. Förmodligen beror det på att jordbruksforskningen kan upplevas som mer splittrad och därför måste man hitta ett upplägg där alla som kommer finner föredrag eller studiebesök intressanta och relevanta.

Iakttas av panelen att SLU borde kunnas synas ännu mer på vissa viktiga konferenser/motsv. (t.ex. Energitinget). Här kan alla intresserade själva anordna seminarier och detta vore en bra arena för SLU att visa sig på.

B 3. SLU:s image

En framträdande bild av SLU är att det är ett sektorsuniversitet och det är livsviktigt för vår näring.

SLUs image är kopplad till hela näringens image; de gröna näringarna har en allt sämre status i samhället men har mycket stor betydelse för den framtida samhällsutvecklingen. SLU ska vara stolt över sin verksamhet. Samhället är mycket fokuserat på miljöskador etc. och då färgas man av det och man borde bli mer lösningsorienterad än som nu problemorienterad. SLU måste stå för att man ser att människans (ansvarsfulla) utnyttjande av naturresurser som något positivt. Tjänster och produktion och förädling av naturresurser är kärnan här. Att man har möjligheten att göra systemanalyser och synteser är ett potentiellt mervärde, inget annat lärosäte har den möjligheten.

Det upplevs som uppenbart att SLU skäms för namnet Lantbruksuniversitetet och SLU bör på allvar överväga ett namnbyte. Life science är emellertid ett mycket utslästat begrepp och inget lämpligt namn. Panelens förslag är istället Sveriges Naturresursuniversitet (SNU).

SLU syns för lite på de nationella arenorna för de gröna näringarna.

SLU är inget policyorgan men måste samtidigt kunna peka på möjligheter. Exempelvis när det gäller stubbrytning, talas nu mest om negativa konsekvenser för biologisk mångfald, medan man också tydligt borde framhålla det positiva med den energimöjlighet som finns etc. Problemformulering och agendan sätts nu av WWF, Naturskyddsföreningen m.fl. och SLU är inte alls med och sätter agendan. Uppfattas snarare som regeringens förlängda arm i problemanalyser.

Ibland kan SLU upplevas splittrat, som ett företagshotell med enskilda forskargrupper med sin egen finansiering.

B 4. Framtida utmaningar

När det gäller tillvägagångssätt och avgörande faktorer för framgångsrika forskningssamarbeten i ett nyttoperspektiv hänvisas till sammanställningen under B2. Dessa faktorer kommer till stor del vara avgörande för nytta även i framtida aktiviteter.

Klimat och energi ska inte kopplas ihop. Energifrågorna har haft och kommer att ha ett värde utöver klimatfrågan och man kan inte sätta likhetstecken mellan klimatforskning och energiforskning. Klimatet har bäring på fler (alla) ämnen. Bioenergi utvecklades långt innan politikerna pekade ut klimatförändringarna som prioriterat område.

Gällande forskningens innehåll har panelens deltagare identifierat följande framtida forskningsområden:

- **Hållbar produktion** (inom jordbruk och skogsbruk). Ett mycket brett begrepp som är kärnan i allt nyttjande av naturresurser. Det är viktigt att SLU kommunicerar att allt vad SLU gör i grunden handlar om hållbar produktion.
- **Klimatförändringens påverkan på naturresurserna** (produktion och miljö).
- **Bioenergiforskning** är ett strategiskt område. För att tydliggöra forskningen kan SLU starta ett samlat bioenergiprogram i form av centrumbildning eller plattform.

- **Effektiv miljöhänsyn.** Utveckla kunskapen och göra synteser om sambanden mellan miljöhänsyn i skogen, dess effekt på biologisk mångfald och skogsproduktion.
- **Skoglig genetik.** Umeå Plant Science Center är en stark grupp inom SLU och rör i första hand växtfysiologi och molekylär genetik men det som inom överskådlig tid/medellång sikt (50 år framåt) kommer att användas inom näringen är kvantitativ genetik och den verksamhet som idag finns på detta område är inte tillräcklig.
- **Skogsteknik.**
- **Bioråvaruproduktion för industriella produkter** inkl. produktutveckling i samarbete med andra. ”Att flytta kemifabriken till fältet”. SLU bör lägga forskningstygdpunkten på de steg som kommer före själva produktutvecklingen.
- **Vedegenskaper i kedjan, ståndort, skötsel, process och produkt.**
- **Växtförädling på jordbrukssidan.**

Andra framtida utmaningar:

- **Synen på SLU** och dess image och hur nyttjande av naturresurser kan ses som något positivt (se resonemang under B3). Panelen för en diskussion om koldioxidreklam-kampanjen. Ska man göra sådana satsningar måste man följa upp dem, en ensam kampanj ändrar inte imagen.
- Att inom SLUs starka/strategiska forskningsområden identifiera forskare, eller andra **talespersoner**, som kan representera SLU (en typ av ”språkrör” eller kontaktpersoner) med uppgift att delta i debatten, positionera SLU och förändra synen på näringen i stort. Genom att sitta i TV-soffor, skriva debattartiklar etc. Dessa personer måste ha stöd av en presstalesman eller liknande som kan hjälpa fram och få media att hitta SLUs experter. Också mer Lisa i TV!
- **Samordning internt.**
- **Samverkan externt** med andra forskningsinstitutioner tex. mellan traditionell skogsforskning och samhällsvetenskaplig forskning om naturresursernas roll i framtida samhälle.
- **Ledarfrågan**, att rekrytera ledare och att utveckla ledare för forskningen.
- SLU behöver **mod för att uppnå världsklass**. Viktiga instrument är att Rekrytera, Utveckla och Avveckla. Därför rekommenderar panelen att SLU inrättar en enhet som underlättar för personal att finna arbetsuppgifter inom annan verksamhet.

C. Övriga synpunkter

Ang samspelet mellan forskning och utbildning

SLU har med sin stora andel forskning och höga lärartäthet en mycket god förutsättning att ha täta kopplingar mellan utbildning och forskning och panelen upplever i stort att man utnyttjar detta.

Ang balansen mellan internt och externt finansierad forskning

Den stora andelen externfinansiering bidrar till fragmenteringen. Allokera resurser till strategiska områden och viktiga grupper.

Satsningen på *Grants office* och stöd till större forskningsansökningar upplevs som väl investerade pengar.

SLUs geografiska spridning

SLUs geografiska lokalisering upplevs ha politiska, strategiska och traditionella grunder. Spontant kan man känna att samarbeten skulle underlättas samt överlappningen och fragmenteringen minska om SLU enbart fanns på en ort. Spridningen har dock fördelar i termer av igenkännande, närhet och lokal diskussion varpå det ändå är en styrka att kunna behålla en geografisk spridning. För att fylla sin uppgift att verka för hela landet måste SLU finnas representerat i hela Sverige. Det är en ledningsuppgift att hantera negativ lokalpatriotism som fungerar exkluderande eller skadligt konkurrerande.

Att SLU har olika image på olika platser (Jmf LTJ-fakulteten och samverkan genom Partnerskap Alnarp eller NL och en jämförelsevis starkare betoning på grundforskning) skapar delvis en otydlighet gentemot intressenterna. Svar på frågor om samverkan med näringen besvaras olika beroende på vilken fakultet man frågar.

Tillkomsten av NL-fak har delvis inneburit en splittring av resurserna i S-fak.

Internationellt samarbete

För att kunna vara världsledande behövs samarbeten och nätverk. Detta kan dock se ut på många olika sätt och handlar i termer av rörlighet hos personalen både om att forskare och lärare ska åka ut och att forskare och lärare bör komma till SLU. Detta bör också innefatta benchmarking med utländska lärosäten på olika områden.

SLUs ”själ” eller kärna

Visionen bör bygga SLUs kärnvärden och spela på känslor och uniktet. Personalen måste känna igen och identifiera sig med visionen. Speciellt om universitet ska ha språkrör eller talespersoner måste dessa känna för SLU och SLUs frågor.

Vad som i *SLUs strategi för forskning, utbildning och fortlöpandemiljöanalys 2009-2012* uttrycks som verksamhets idé är mycket bra. Panelen förstår att miljöanalys är ett specifikt uppdrag universitetet har men begreppet och formuleringen kring fortlöpande miljöanalys upplevs som smalt och för passivt och bör omprövas.

Övrigt

Bilden av SLU samt SLUs agerande splittras av de olika uppfattningar som råder om hur jordbruk ska bedrivs inom den traditionellt vetenskapliga delen och de mer idéburna odlingsformerna. De mer idéburna odlingsformerna domineras idag av eko-odling och menar att tillförsel av industriellt kemiskt, eller biologiskt modifierade framställda produkter eller växter är onaturliga och skadliga och inte ska användas inom livsmedelsproduktion. SLU måste på ett bättre sätt kunna hantera att de två linjerna förekommer och att det får finnas olika uppfattningar men SLUs uppgift är också att utreda och tydliggöra vad som bygger på kunskap av vetenskaplig grund och vad som är idéburet. Om man jämför med området humanmedicin finns inte samma konflikt men man arbetar aktivt med att minimera biverkningar från de mediciner som ger stora fördelar vid hälso- och sjukvård. Liknande otydlighet råder i hållningen gentemot användning av slam på jordbruksmark, respektive användning av gmo inom växtförädling. När SLU inte kan prestera en klar hållning blir hela samhällsdiskussionen vilsen. Precis som ett företag kan man skapa en efterfrågan och intresse och då får man resurser för att genomföra sin version. Ett hot för SLU är att inte ligga i framkant eller har en framskjuten position när imagen för sektorn vänder och resurser tilldelas. Paradoxen ligger i takt med att imagen ändras och får en mer positiv prägel ju större blir konkurrensen och desto mer attraktivt är det för andra aktörer att finnas med på området och konkurrera med SLU.

Panelen har diskuterat departementstillhörighet för SLU och kommit fram till att nuvarande ordning är den bästa.

Rapport från intressentpanel

IV. Samhällsplanering, miljö och natur (Stad—land, rekreation, hälsa och fritid)

A. Sammanfattande bedömning för området

Samhällsplaneringen är en lite avvikande gren på SLU:s träd, inte bara för att man endast sekundärt är kopplad till de agrara näringarna utan framför allt för att både utbildning (av framför allt landskapsarkitekter) och forskning har en helt annan målgrupp än de andra verksamheterna inom lantbruksuniversitetet. Landskapsarkitekter och samhällsplanerare utgör snarare en del av det ”byggindustriella komplexet” i Sverige, än att man har en aktiv roll inom de areella näringarna. Samtidigt vill gruppen betona att landskapsarkitekternas kunskapsgrund i växtmaterial och vegetation, med vad det innebär för kunskap om ekologiska system och naturvetenskapliga förutsättningar för planeringen, är den viktiga aspekt på yrket och utbildningen som gör den unik. Att detta ger en koppling till resten av SLU, är uppenbart.

Utvärderingsgruppen har också funnit att SLU:s främsta styrka ligger i de starka ”varumärken” som deras yrkesutbildningar utgör. Liksom landskapsarkitekt, är agronom, veterinär, osv., titlar som är kända av allmänheten och inger respekt och förtroende. Inom vårt område är det viktigt att bevara och utveckla baskompetenser i att förstå, designa, planlägga och förvalta både kultur- och naturlandskapet. En sådan grund är nödvändig för att de SLU-utbildade även framöver ska kunna bidra till att anta framtidens utmaningar.

Det är också i professionsanknuten forskning, i anslutning till dessa yrkestitlar, som SLU är unikt i landet och kan bygga unika profiler även inom forskningsfält som anknyter eller delas med andra universitet och institutioner. Detta gäller också för forskning om samhällsplanering och (landskaps-)arkitektur. I centrum av fältet finns de professionsrelaterade frågorna med betoning på landskapsarkitektur men också frågor rörande fysisk planering och stadsbyggnad i vidare mening, som grund för utbildningen och relaterat till landskapsarkitekternas starka inbrytning i samhällsplaneringen.

Även om ”landskapsuniversitet” inte har sin största betydelse i samhällsplaneringssektorn vill gruppen dock betona det starka värde som utbildningsanstaltens namn har både inom och utom yrkeskåren. Både Ultuna och Alnarp ger associationer av West Point som SLU bör värda.

Gruppen berör ett antal frågeställningar som man menar är viktiga att forska kring, inte så mycket beroende på att man saknar sådan forskning, som att man utifrån sitt yrkesperspektiv ser den som relevant. Allmänt kan nämnas utvärderingsmetoder av upplevd kvalitet, utveckling av kunskapsmassan för landskapsarkitekter, beskrivning och problematisering av

de yrkeskvaliteter som krävs i bygg- och planlagstiftning som PBL och MB. Aktuella frågor som pockar på många och olika lösningar, är bl.a. klimatfrågan som ger samhällsplaneringen fokus på nygamla, konkreta gestaltande och tekniska utformningar för att skapa lösningar som både är tekniskt möjliga, ger relativt liten naturpåverkan och framför allt är ekonomiskt och socialt hållbara. Begreppet ”hållbar stad” är också ett aktuellt mål för planeringen som kräver fortsatt forskning för att kunna beskriva och definiera hållbar täthet, regionprinciper, transportsystem och produktionslandskap. Gruppen pekar också på SLU:s möjligheter att sammanföra forskare inom samhällsplanering med de inom jord- och skogsbruk som arbetar med landskapsplanering utifrån produktionstekniska aspekter. Dessa tvärvetenskapliga synsätt blir sannolikt viktiga inför framtidens omställning av agrar produktion samtidigt som landsbygden och landskapet också har en urban betydelse som bostads- och rekreationsområde.

Hur lyckas då SLU idag som forskningsmiljö inom samhällsplanerings- och arkitekturforskning? Arbetsgruppen konstaterar lite ironiskt att även i denna grupp, som plockats ut på grund av dess relativt aktiva och medvetna förhållande till SLU, så är kunskapen dålig om vad som faktiskt forskas om. Oavsett vad detta beror på, kan man konstatera att SLU uppenbarligen har ett problem med att nå ut med forskningsresultat, respektive engagera branschen i sina frågor och ämnen. En utveckling av kommunikationen av forskningsfrågor och resultat är därför viktig, oavsett om det är forskarna eller vi ignoranta ”praktiker” som är grundorsaken. På kommunikationstemat framhåller gruppen också vikten av att SLU utvecklar sin interna kommunikation, för att undvika överlappningar och optimera resursutnyttjandet.

Trots denna pessimistiska inledning uppfattar gruppen forskningsmiljöerna på SLU som relativt framgångsrika inom området, ett område som i sin helhet har varit mycket tillbakaträngt på grund av statsmakternas förändrade prioriteringar. Gruppen ger därför forskarutvärderingarna rätt i att SLU har tämligen goda förutsättningar att utveckla forskarmiljöer inom området samhällsplanering.

B. Kriteriebedömningar

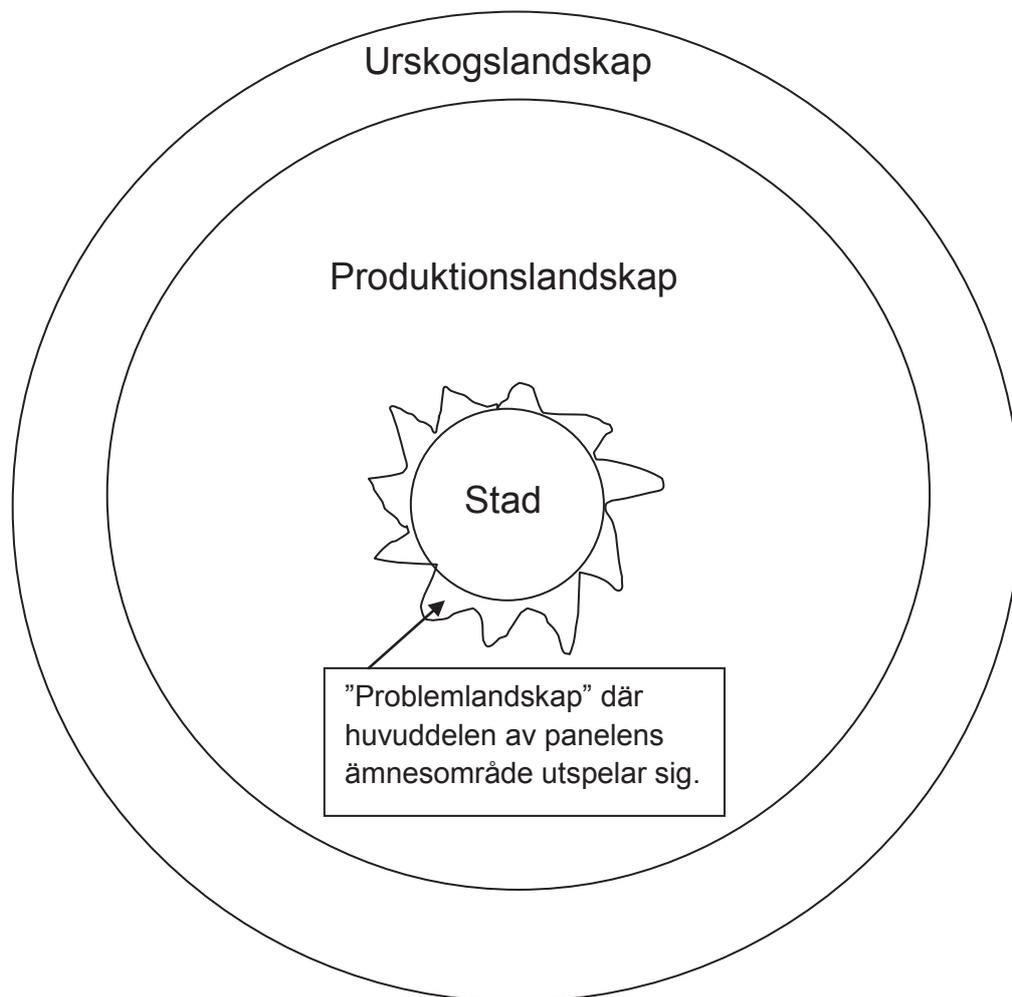
Panelmedlemmarnas samlade kunskap om SLU:s verksamhet inom området är naturligtvis inte alls komplett. Våra synpunkter speglar aktuellt kunskapsläge (om SLU:s verksamhet) hos en grupp centrala intressenter. Vår utnämning av oss till ”centrala intressenter” vilar på det faktum att vi har blivit tillfrågade att göra denna utvärdering.

Panelens tyngdpunkt (4 av 6 panelmedlemmar) i landskapsarkitektur/arkitektur är också nämnvärd som bakgrundsfaktor för utvärderingsresultatet. Viss ”slagsida” åt landskapsarkitektur har alltså varit svår att undvika. Samtidigt har friluftsliv och skog också varit representerade, och panelarbetet har inneburit mycket intressanta utbyten mellan våra discipliner.

Vi hade haft en mer komplett bild av SLU:s forskning inom området om vi, i god tid innan utvärderingsarbetet, haft tillgång till hela dokumentationen för de relevanta vetenskapliga panelerna. Vi förstår samtidigt SLU:s val att av olika skäl begränsa spridningen av nämnda dokumentation.

Relevanspersonerna för ”vår” huvudsakliga vetenskapliga panel, ”Landscape Architecture, Urban and Rural Development”, hade tyvärr inte möjlighet att medverka under första utvärderingsdagens presentationer.

Ett sätt att illustrera vårt panelområde är med dess huvudsakliga ”geografiska” delar, se *Figur 1* nedan.



Figur 1. Huvudsakliga ”geografiska” områden inom ramen för ”Samhällsplanering, miljö och natur”.

Att huvuddelen av vårt område utspelar sig i gränzonen mellan stad och produktionslandskap är vår tolkning. Samtidigt har vi under panelarbetets gång sett intressanta utmaningar i att involvera samhällsplaneringens verktyg i frågor som mer utpräglat handlar om produktionslandskapet. Och att, i andra riktningen, hämta verktyg som rör produktionslandskapets utformning in i samhällsplaneringen.

B.1. Teknisk kvalitet och relevans

Utvärderingens betoning av forskningens potential snarare än resultat, kan givetvis tas som en billig ursäkt, men kan också tas på allvar som utgångspunkt för en nyttobedömning inför framtiden. Förutsättningarna för hela forskningsfältet har varit dåliga då medel och fördelning av anslag har varit mycket begränsad under de senaste femton åren. Detta gäller fler universitet än SLU och SLU:s omfattning av professionsanknuten forskning om samhällsplanering är i en jämförelse rätt god.

Branschen, dvs bygg- och planeringssektorn, lider idag av en rad akuta kunskaps- och kompetensbrister (se t.ex. de olika PBL-utredningarna under 00-talet) och behöver därför en professionsorienterad forskning mer än någonsin. Att ”det kvalitativa språnget” då inte är gjort, kan faktiskt utgöra en taktisk fördel idag.

I panelarbetet tog vi utgångspunkt i framtida utmaningar inom området. De forskningsområden som nämns under B.1.1 – B.1.3 nedan är alltså sådant som adresserar de framtida utmaningar som diskuteras under B.4 nedan. Den ordning vi nämner enskilda forskningsområden nedan är ingen prioriteringsordning.

B.1.1 Hög relevans och hög kvalitet

Miljöpsykologi har hög kvalitet och relevans. Framgångsfaktorer är tvärdisciplinär nisch tajmad med ett starkt behov i samhället, samt goda akademiska samarbetspartners nationellt och internationellt.

Miljökommunikation bedömer vi av hög relevans och vi noterar att den vetenskapliga panelen ger området mycket positivt omdöme.

Vi konstaterar att båda dessa forskningsfält, som särskilt har fångat vår uppmärksamhet, ligger i periferin av området som helhet. De är ”stöddämnena” i samhällsplaneringen.

B.1.2 Hög relevans utan bedömning av kvalitet

Multifunktionell design för optimering i miljöproblematiske områden. Exempel på ett sådant område är biologisk mångfald. Befintlig forskning har fokus i att påvisa förändringar av den biologiska mångfalden, inte i så stor utsträckning på metoder för att bevara och utveckla den. Vi uppfattar att Kjell Danell, Lena Gustafsson och Roland Gustavsson vid SLU bedriver viss forskning av det senare slaget.

Friluftsforskning - Ett område som har naturligt hemvist vid SLU eftersom det är arealbundet. Detta kan handla om konsekvenser av att det tillkommer nya typer av markägare. Internationaliseringen av friluftslivet är en annan viktig aspekt. Förutsättningar för småföretagande inom friluftssektorn är ytterligare ett område som bör uppmärksammas. Lars Kardell och Sven G Hultman har tidigare forskat inom området, nu bedriver Anders Lindhagen sådan forskning vid SLU.

Förflyttningslandskapets utformning – Behovet av transporter ökar, och därmed behovet av forskning kring hantering av transportflödena. Flödenas lokalisering i landskapet och design av flödesplatser är exempel på delområden. Detta handlar inte bara om den ”stora infrastrukturen”, även finmaskigare gestaltungsfrågor är centrala, exempelvis att städer ska vara gå- och cykelbara. Eivor Bucht och Bengt Persson har sedan länge forskat kring detta. Framåt ser vi att SLU kan ta initiativ till brett samarbete med exempelvis kommuner och Vägverket. Ett aktuellt projekt inom området är ”Vägen i staden” (ARKUS/vägverket).

Gestaltning av det offentliga rummet – Här finns funktionella och visuella aspekter men också, inte minst, ekonomiska. Kräver reflektion kring balansen mellan landskap (grönstruktur) och arkitektur (samhällsbyggnad). Christer Bengts bedriver forskning inom området vid SLU.

Förstå – planlägga – designa – förvalta – Viktigt att det finns forskning kring att förstå och utveckla grundläggande kompetenser för yrkesutbildningarna. Avgörande att basämnen för utbildningen, som inte ligger i forskningsfronten, inte utarmas. Exempel på sådana områden kan vara planprocessen, yrkesspecifika färdigheter, historisk beskrivning och analys samt regelverk med bäring på samhällsplanering. Det handlar om verktyg för analys, planläggning, design och förvaltning av både stadens och landsbygdens landskap. Gäller särskilt mot bakgrund av samhällsplaneringens ökande komplexitet och därmed behovet av tvärdisciplinära angreppssätt. Se även *Figur 2* nedan.

Värdering av miljöeffekter – Verktyg för att ge underlag för prioriteringar bland miljöåtgärder. Vad ger mest miljö för pengarna? Forskning inom denna sfär bedrivs bl.a. vid SLU:s institution för ekonomi.

Multifunktionella planerings- och brukningsmetoder – Här befinner vi oss i mötet mellan samhällsplaneringen och produktionslandskapet. Inte minst med utgångspunkt i våra paneldiskussioner ser vi möjlighet till ömsesidigt utbyte av att integrera dessa båda ”kulturer”. Här kan rymmas: upplevelsenäringens utveckling, ersättning till ekosystemtjänster, brukarnas landskapsbeslut etc. Rörande planering vill vi nämna den verksamhet som bedrivs vid Skoglig resurshushållning med Heureka-projektet, och den stora satsningen inom Future forest-projektet. Här finns också en potential att söka alternativ i skötselåtgärder kopplade till brukandet och att i både planering och skötsel ta intryck av den landskapsplaneringskultur som finns i vår panels huvudfåra.

B.1.3 Hög relevans men okänt för panelen vad som görs vid SLU

Klimatanpassade stadstyper – Vilka är hotbilderna och hur ser riskerna ut i tid och rum? Vilka krav ställer detta på kommunal teknik och, av särskilt intresse för SLU, blå/grön teknik? Här krävs metoder för att möta de konsekvenser som klimatförändringarna får på landskapets olika delar. I det urbana sammanhanget är hanteringen av större regnmängder och högre temperatur exempel på konkreta utmaningar.

Idéutveckling kring det hållbara samhället – Här ser vi, förutom forskning, ett starkt behov av SLU:s aktiva deltagande i samhällsdebatten. Kräver komplext balanserande av olika intressen och diskussion kring ”miljödogmatism” av typen ”ingen art får dö ut i Sverige”. Konkretisering av forskningsområden kan vara konsekvenser för landskapet av ändrad energiförsörjning och förvaltning av grönstrukturer.

Visualiseringsmetoder – Möjligheterna att tillgängliggöra kunskap om exempelvis landskapsförändringar eller skapa förutsättningar för samhällsförankring av landskapsåtgärder förbättras med effektiva visualiseringsmetoder. Forskning kring detta är också av central betydelse för forskningens nyttogörande generellt.

Utvärdering av ”upplevd” kvalitet i den fysiska miljön – Metoder för att öka brukarnas delaktighet i utvecklingen av ”sin” miljö. Ett komplement till, och underlag för utveckling av, arkitektprofessionens bedömningar.

Scenarioplanering – känslighetsanalyserande ”simuleringar” av hur exempelvis klimatförändringar, migration eller politikskiftet påverkar det areella nyttjandet. Scenarioplaneringen är en unik och kraftfull metod i dessa sammanhang.

B.2. Funktionell kvalitet

Enligt våra instruktioner ingår här *hur* kunskapen utvecklas, paketeras och förmedlas. Kunskapens utvecklande, i betydelsen forskningsmetoder, berörs något under B.1 ovan, men inte ytterligare här i generell mening.

Angående paketering och förmedling av kunskap kan med viss ”glimt i ögat” sägas att SLU:s brister i sammanhanget illustreras av vår begränsade kunskap om SLU:s verksamhet inom ”vårt” område. Vi önskar samtidigt att ”blinkningen” tas på visst allvar, då vi ser kontinuerlig kommunikation med ”praktiken” som nödvändig näring i utvecklingen av SLU:s funktionella kvalitet. Därmed är det nästan redan sagt att den utvärdering, som vi här deltar i, är ett substantiellt bidrag till hög funktionell kvalitet.

Som goda exempel på framgångsrik paketering och förmedling av kunskap vill vi nämna MOVIUM och MKB-centrum.

En aspekt på kommunikation, som bör ges högsta prioritet, är att förbättra den interna kommunikationen mellan SLU:s ämnesområden för att undvika överlappningar och optimera resursanvändningen.

B 3. SLU:s image

I diskussionen kring SLU:s image uppfattar vi att nedtoning av ”bondestämpeln” betonas starkt, inte minst internt inom SLU. Vi ser delvis en fara i att gå för långt och snabbt i den riktningen. Det finns starka varumärken, som är viktiga att vårda, i de traditionella ”areella begreppen”, exv. agronom och jägmästare.

SLU:s orter och ”Slotten/Herrgårdarna” är något vi ser skulle kunna användas mer som imageskapare.

Samtidigt är det oundvikligt att nya begrepp med aktualitet i samhällsutvecklingen behövs för att ge organisationen större legitimitet och för att nå nya målgrupper. En slutsats som dras bl.a. i dokumentationen av de intervjuer med SLU-intressenter, som har genomförts inom ramen för KoN-projektet.

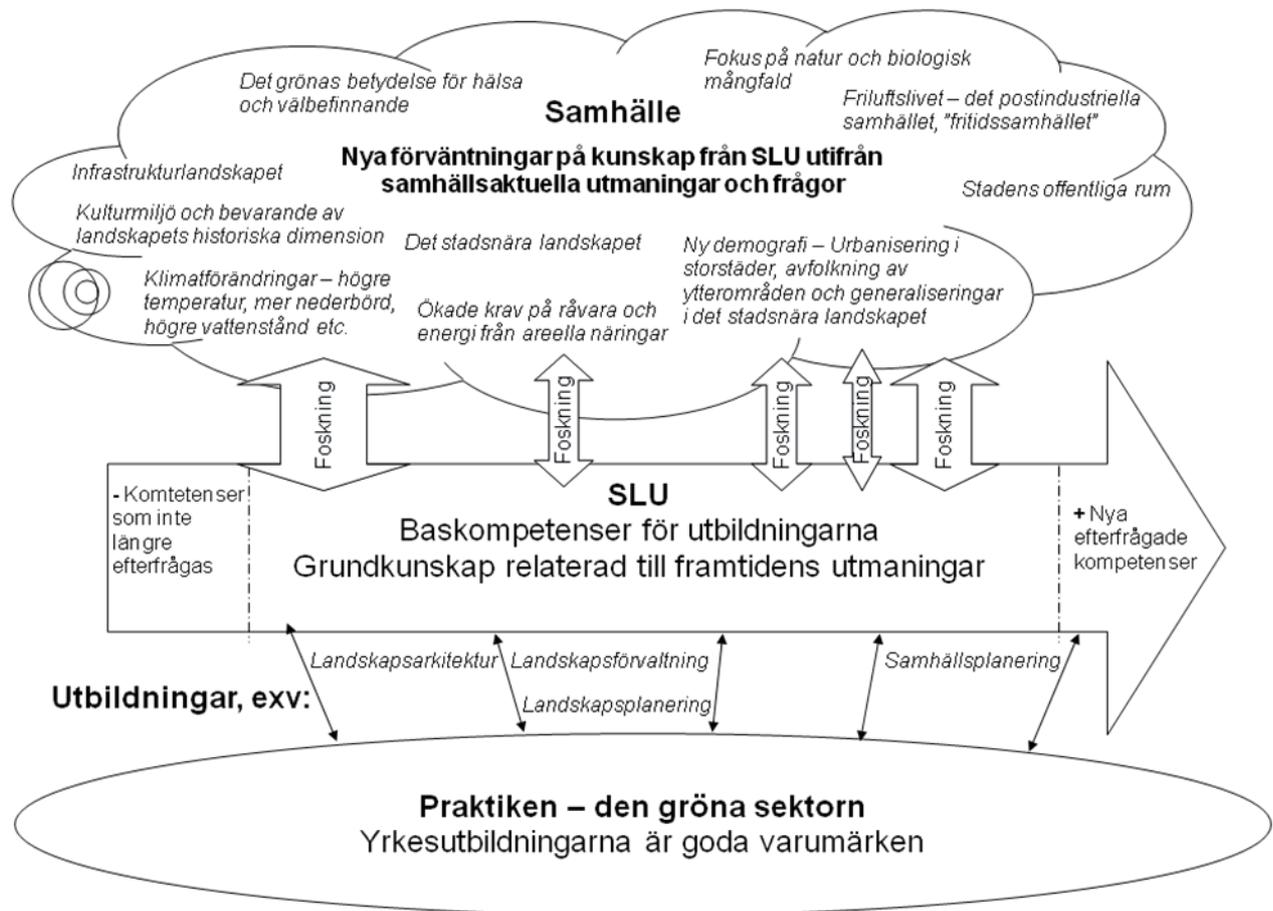
Vi håller med om att de styrkeområden som SLU har formulerat i sin strategi för 2009-2012 kan bidra till att stärka SLU:s image och därmed till att nå nya målgrupper. Vi ser att styrkeområdena signalerar att SLU är med i samhällsutvecklingen, SLU vill samverka och delta i de strategiska problemformuleringarna. Samtidigt vill vi betona att sådan imageutveckling inte bör ske på bekostnad av SLU:s ”traditionellt” starka varumärken.

Med utgångspunkt i vårt panelområde konstaterar vi att samhällsvetenskap generellt har en svag position i SLU:s image, det vore bra för SLU som helhet om den positionen kunde stärkas. Ett skäl till sådan förstärkning, med koppling till vårt område, finns i devisen ”miljöproblem är samhällsproblem”.

B 4. Framtida utmaningar

Som nämnts ovan började vi panelarbetet med brainstorming kring framtida utmaningar, vilket blev underlag för formulering av forskningsområden (B.1 ovan) som adresserar dessa utmaningar. Ordningen är inte heller här någon prioritetsordning, även om det uppenbart är

utmaningar av mycket varierande dignitet. En övergripande illustration av SLU i relation till de framtida utmaningarna ges av *Figur 2* nedan.



Figur 2. SLU i framtidens utmaningar.

B.4.1 Övergripande – människa/natur/samhälle

Internationalisering – Innebär ökad konkurrens på den globala forskningsarenan. Inom Europa kanaliseras allt större andel av de totala forskningsresurserna via EU-systemet, vilket kräver internationella partnerskap i konkurrensen om forskningsresurserna. Samtidigt är internationalisering som strategi en nödvändig förutsättning för att möta andra globala utmaningar.

Klimatförändringar – Med utgångspunkt i vårt panelområde är utmaningen att hantera konsekvenser för människans areella nyttjande. Inom en sådan avgränsning är fokus på att skydda mänsklig aktivitet från miljön snarare än att skydda miljön från mänsklig aktivitet.

Externa effekter av areell produktion - Exempelvis läckage av närsalter till Östersjön eller utarmning av biologisk mångfald.

Segregation – Segregationen ökar i olika geografiska skalnivåer. Ett stort antal kommuner klarar knappast längre att finansiera basfunktioner som vård, skola och omsorg, än mindre att utveckla IT-system, samhällsplanering och att behålla tillräckligt hög kompetens hos personalen. Samtidigt växer universitetsstäderna så det knakar med stor brist på bostäder,

parker, infrastruktur osv. Hur ska små landsbygdskommuner utveckla sin samhällsplaneringsfunktion – behövs nya nätverk av småkommuner för att hantera t ex stadsbyggnadsfrågor och fysisk planering? Segregationen finns också lokalt, och framförallt i större städer. Stadsdelar växer ifrån varandra i ekonomisk och social mening men också rent fysiskt genom infrastrukturens barriäreffekter. Hur kan samhällsplaneringen motverka eller hantera oönskad social och ekonomisk segregation?

Infrastrukturlandskapet - Den moderna infrastrukturen är mycket storskalig och ska utformas såväl för trafikantupplevelsen som för de som brukar och använder det omgivande landskapet. Detta är en komplex situation med stor långsiktig betydelse för stads- och landskapssammanhang. Hur påverkas planeringen av ökande koncentration (större andel av befolkningen i städer) och volym i transportflödet? Det moderna livet och behovet av förflyttning skapar allt fler omstigningsplatser (busshållplatser, parkeringar, resecentran etc). Dessa ska vara effektiva, trygga och säkra. Samhället lägger stora resurser på detta och de måste gestaltas med stor kunskap om såväl trafik som human- och arkitekturvetenskap. Inom städerna och mellan orter får stråk och cykelvägar ökande betydelse. Hur ska dessa passas in i stads- och produktionslandskap och vara trygga, effektiva och upplevelserika? Infrastrukturlandskapet ska sättas samman och ges en gestaltning. Utan ett väl utformat infrastrukturlandskap med bra omstigningsplatser får vi också svårare att uppnå hållbara transportstrukturer och en miljöanpassad livsstil.

Det offentliga rummet, formgivning och finansiering - Allt fler människor vistas i täta stadslandskap. Allmänt ägd utemiljö, torg, gator och parker ska fungera för en mängd målgrupper med delvis olika förutsättningar, kulturell bakgrund etc. Hur ser mångfunktionella parker, torg och gator ut? Vilken nytta och betalningsvilja finns för de kvaliteter som det offentliga rummet medger? Hur arbetar man i andra länder med det offentliga stadslandskapet, vilka trender finns? Kan och bör utvecklingen mot muromgärdade parker med låsta grindar förhindras?

B.4.2 Landsbygd i förändring

Urbanisering och å andra sidan *gentrifiering* – där den senare står för medelklassens ”erövring” av landsbygden.

Energiförsörjning – Omställning till förnyelsebara energikällor. Hur påverkas landsbygden av ökad odling av biobränslen och fler vindkraftverk?

Livsstilsförändringar – Exempelvis konsekvenser av ändrade konsumtionsmönster.

Markkonflikter - Hårdnande försvar av äganderätten i förhållande till allemansrätten. Ökande konflikt mellan markägande och andra intressen.

Planverktyg för areell produktion - Kan landskapsplanering vara ett verktyg för hantering av miljöeffekter från produktionslandskapet?

C. Övriga synpunkter

En specifik fråga av organisatorisk karaktär, som rests i våra diskussioner, är vad SLU vill med två lenheter (Alnarp och Ultuna) för landskapsarkitektur och två utbildningar för landskapsarkitekter?

Rapport från intressentpanel

V. Fortlöpande miljöanalys

A. Sammanfattande bedömning för området

FOMA ÄR BRA!

Panelen ser verksamheten inom Foma som betydelsefull för samhällets fortsatta planering och uppföljning av naturresursplanering och miljömål. Fomas verksamhet är vidare av stor betydelse för intressenterna. Förutom detta anser panelen att Fomas nuvarande verksamhet och uppbyggnad till de större delarna är mycket effektiv. Panelen anser också att programmen inom Foma genomförs med stort engagemang och professionalitet. Trots detta anser vi emellertid att det finns organisatoriska liksom andra aspekter på FoMA som kan och bör förbättras för få ut mer och bättre nytta av Foma.

Följande byggstenar är viktiga att säkra:

- Långsiktigt och kvalitetssäkrad dataförsörjning och öka tillgängligheten till data, både för användare internt och utanför SLU.
- Lång, tillräcklig och säkrad medelstildelning
- Data skall vara modernt tillgängliga internt och externt för analyser, forskning och uppföljning.
- Resultaten ska nå och förstås av användarna!

Panelen efterlyser en kompletterande omvärldsanalys:

- Som beaktar mer än de explicita miljömålen som underlag för Fomas verksamhet
- Som utförs tillsammans med intressenterna (exempelvis tillsammans med en breddad referensgrupp)
- Där miljömål och lagstiftning ges tydliga uttalade uppföljningsmöjligheter
- Där andra övergripande processer, framtida miljö- och produktionsscenarier mm tas med i analysarbetet.
- Som leder fram till underlag för Fomas verksamhetsidé, verksamhetsbeskrivning och programförklaringar.

Verksamhetsidén bör förtydligas och utvecklas

- Idag är den otydlig, osynlig och ger ett för ”smalt” intryck. Utöver detta har den inte genomslag i verksamheten.
- Verksamhetsidén bör utvecklas tillsammans med externa intressenter och synliggöras inom organisationen.
- Den bör vidareförädlas och konkretiseras i verksamhetsbeskrivningar och programförklaringar
- Foma bör vidare utveckla en strategi för hur och om man ska ”värdera resultat eller endast leverera information”.

Tydligare ledningsstruktur och tydligare prioriteringar

- Foma bör ha en beslutande styrgrupp bestående av övergripande medelstillsdelare och ansvariga för Fomas program och uppföljning.
- Foma bör också ha en aktiv rådgivande grupp bestående av en vid grupp intressenter inklusive NGO och sektorsföreträdare.
- Vicerektor för Foma underställd styrgruppen.
- Koordinatorerna bör vara underställda vicerektorn och ha tydliga mandat och beslutsfunktioner.

Organisation

- Bilda större programenheter kluster av program.
- Utveckla samarbetet mellan nuvarande program (1+1=3) för att utnyttja överlappande eller kompletterande kompetenser, skapa kritisk massa och förenkla resursfördelningen
- Med större enheter finns bättre möjligheter och större personella resurser till forskning, vetenskaplig publicering och kommunikation

Nya interna och externa arenor för att integrera SLU:s kompetenser

- Årlig Foma-konferens
- Strategiskt tänk kring externa samarbetspartner – kompletterat kunnande

Viktiga framtidsutmaningar

- Positionera Foma gentemot andra aktörer
- Skapa en stabil och tydlig organisation
- Bryt stuprören
- Involvera interna och externa intressenter
- Utöka samarbetet internt, externt och internationellt.
- Tänk igenom och utöka samarbetet med andra universitet
- Säkra karriärvägar och ta fram en strategi för kompetensförsörjning för statistiker, kommunikatörer, GIS-analytiker och andra specialister.
- Säkra erfarenhetsutbytet avseende ny metodik och forskning.
- Bevakning av pågående forskning inom området, evaluering och ställningstagande till nya tekniker för datainsamling och modellutveckling

B 1. Teknisk kvalitet och relevans

Vi anser att Foma i huvudsak gör rätt saker. Vi kan inte gå igenom alla programmen men lyfter här fram våra erfarenheter från några av programmen.

Inom panelen finns goda erfarenheter av *riksskogstaxeringen*. Några framgångsfaktorer för detta program är långa dataserier, serviceinriktning, kvalitet på datainsamlingen och kontinuitet. Till programmet finns en referensgrupp med huvudintressenterna som normalt sammanträder två gånger om året. Vid de större genomgångar som görs vid omdrev har avvägningar gjorts på ett bra sätt mellan gammalt och nytt. Att programmet har haft långsiktig finansiering har underlättat etableringen av forskning kring programmet. Detta har gynnat programmets utveckling. Många intressenter har både varit med i taxeringen och bedrivit egen forskning mot bakgrund av det stora dataunderlaget. Informationen kring programmet

har skötts skickligt så att många har känt till att det finns mycket att forska på. Programmet har sedan länge varit ett viktigt underlag för beslut och skogspolitiska utredningar.

Panelen har också goda erfarenheter av centrum för *kemiska bekämpningsmedel*, CKB, som har utfört uppdrag väl. Inom programmet finns nära kontakter med avnämarna när det gäller organiska risksubstanser och modeller. Programmet har utvecklat användbara metoder. Det är fokuserat och har väl utnyttjat synergier inom SLU. Programmet är proaktivt och initierar nya viktiga aktiviteter

Klimatprogrammet har potential men ännu inte kraftsamlat kring klimateffektfrågor. Inom programmet för *klimat* har farhågor uttrycks för att komma alltför nära politiken genom att krav har ställts på att göra de politiska avvägningarna mellan olika alternativ. Man har velat lämna goda underlag för beslut men samtidigt haft en önskan att överlåta värderingar åt berörda myndigheter. Vi ser det som naturligt att Foma strävar efter att lämna ett så vetenskapligt underlag som möjligt men att också belysa osäkerheter i bedömningen och, i vissa fall, konsekvenser av olika alternativa handlingsvägar. De politiska avvägningarna bör dock göras inom de politiska processerna. Inom andra program har dock inte denna farhåga lyfts utan snarare uttrycks ett behov av djupare analys och konsekvensbedömningar. I verksamhetsidén finns uttalat att Foma ska *värdera problem* att det är oklart vad som egentligen avses i denna del av verksamhetsidén.

Panelen har också några generella reflektioner kring programmen:

- Prioriteringsprocessen mellan programmen syns oss vara svår att förstå och tycks till stor del var historiskt baserad. Vi är inte övertygade om att balansen mellan programmen är rätt och efterlyser en större inblandning från intressenter i prioriteringsarbetet.
- Mer kunde göras inom flera av programmen genom ett bättre utnyttjande av den forskning som finns inom SLU. Programområdena tycks inte vara kraftsamlade
- Kontakter med andra lärosäten har inte redovisats. Omvärldsanalysen är inte tydlig och vi kan inte se att SLU:s positionering är genomtänkt.
- Grunden i Fomas verksamhet är insamling av data. Genom utveckling av modeller kan kunskap generaliseras vilket påverkar datainsamlingen. Modellutveckling och datainsamling bör gå hand i hand. I vissa program är större delen av arbetet inriktat på modeller. Inom andra områden saknas dessa. ArtDatabanken borde kunna utnyttja modeller bättre. Modeller finns för hur arter kopplas till substrat men det vore värdefullt att ha modeller för hur den biologiska mångfalden påverkas när klimat, markanvändning eller skötselmetoder förändras.
- Panelen bedömer att det finns modellkunskap inom andra delar av SLU som borde kunna komma Foma till godo.
- Panelens erfarenheter är att SLU har varit en god rekryteringsbas för andra myndigheter och företag.
- Någon kommersialisering av verksamhet inom Foma har inte redovisats. Panelen kan inte se att detta skulle vara en huvuduppgift för verksamheten. Däremot säljs en hel del tjänster. Panelen bedömer att det borde finnas möjlighet att också sälja utbildningar med underlag av de erfarenheter som finns inom Foma.

B 2. Funktionell kvalitet

Generellt anser vi att verksamheten och resultaten kunde presenteras bättre så att de blir mera kända och tillgängliga bland forskare, myndigheter och allmänheter. Olika informationsvägar behövs för de olika grupperna. Sökbar information på webben är värdefull eftersom det oftast inte går att förutse vilka som kan vara intresserade. ArtDatabanken har på ett föredömligt sätt fått ut ett material som är av stort intresse för allmänheten. ArtDatabankens metod att samla in data genom att engagera allmänheten borde kunna användas mer om den kan bli generellt statistiskt säkerställd.

Samverkan mellan olika delar av verksamheten inom SLU kan ge mervärden på två sätt. Dels ger det möjligheter att effektivisera verksamheten genom samarbete inom samma problemområden, dels skapas synergieffekter genom att kompetenser från olika områden sammanförs för att lösa komplicerade problem.

Ett exempel är att bättre utnyttja SLU:s stora kompetens inom jordbruksområdet. SLU har experter på hur markslag, jordmånstyper och odlingsslag påverkar läckaget av såväl fosfor och kväve. Genom Foma är det också känt vilka vatten som har problem med övergödning. Tillsammans kan kunskaper inom båda dessa områden ligga till grund för praktiska, generella råd om hur läckage som beror jordtyp och avrinningsförhållanden bäst kan minskas genom ändrade grödor, användandet av skydds-zoner och flera andra åtgärder. En sådan praktisk kunskap kan användas av länsstyrelser eller kommuner vid diskussioner med lantbruket om hur man med förhoppningsvis enkla åtgärder kan minska läckage av näringsämnen. Råden skulle kunna samlas i en handbok eller en informationsbroschyr. I detta arbete gäller det att ha ett brett angreppssätt. Metoder som är optimala för att begränsa växtnärläckaget kan vara ineffektiva (eller t.o.m. kontraproduktiva) för andra miljöeffekter. Odlingen av fänggrödor leder till exempel till ökad användning av glyfosat. Skötsel av skydds-zoner kanske kan kombineras med blommor och biologisk mångfald. Effekter av åtgärderna bör alltså även vägas mot klimat och biologisk mångfald. SLU har kompetensen.

Vilka konsekvenser som olika handlingsvägar har går först att värdera när den samlade effekten vägts in. Sammanfattningsvis: ett utvecklat tvärvetenskapligt angreppssätt, samverkan mellan Foma-programmen och närvaro i samhällsdebatten är viktiga framgångsfaktorer.

Fomas struktur bör ses över för att ge samverkan och utnyttja beröringspunkter mellan olika program. En annan skärning bör övervägas för att ta bort stuprör. Eventuellt bör övergripande teman övervägas. Samtidigt ser vi att det behövs ambassadörer för Foma både inom och utom SLU. Om antalet program minskas bör detta kompensera. Dessutom är det nödvändigt att hitta former för samverkan med forskningsmiljön så att hela SLU:s kompetens kan utnyttjas.

Samverkan med intressenter bör ses över. Vi anser att nya former för samverkan med intressenter bör tas fram som blir effektivare och snabbare än traditionella referensgrupper.

Programövergripande strategiska referensgruppsmöten med en bredare grupp intressenter skulle kunna vara ett bra alternativ. Idag är ofta intressentgrupperna för snävt sammansatta. Denna strategiska referensgrupp skulle kunna användas för att gå igenom de olika programmen och göra ekonomiska avvägningar och prioriteringar. Dessutom bör detta kompletteras med nya fora för samverkan.

Komplettera med nya fora och nya sammanhang. Utnyttja internationella konferenser.

Diskutera omvärldsanalys och strategier. Tänk nytt!

Programmen har nyligen sökt kontaktpersoner men det är oklart vilken roll dessa ska ha och vilka som har inbjudits. Inbjudan skulle kunna gå till en bredare grupp av intressenter.

Foma borde känna till vilka centrala dataset som finns inom alla delar SLU. Viss rädsla för att lämna ut data är begriplig men metadata bör vara allmänt tillgängliga. SLU bör ha en strategi för detta.

Vi anser också att de kontaktpersoner som Foma har hos olika intressenter måste ha tillräcklig med tid avsatt för arbetet för att verkligen kunna bidra och konkretisera vad som behövs och i vilken form resultaten måste föreligga för att bli användbara.

B 3. SLU:s image

Panelen anser att SLU är ganska känt inom sektorn men inte utanför. Universitetet har bra image och gott anseende.

Samarbete med andra universitet inom Foma har inte lyfts fram i redovisningarna och inte den internationella samverkan heller. Positionering i förhållande till andra bör ske.

SLU:s verksamhet ger mervärden kopplade till näringen. Utvecklad samverkan med ekonomer och samhällsvetare skulle kunna leda till bättre underlag till åtgärder. Viktigt att ta fram åtgärder som gör det möjligt samtidigt att uppnå många olika mål, t.ex. både biologisk mångfald och produktion. Här finns en kompetens inom SLU inom både skogsbruk och jordbruk. Denna potential utnyttjas inte till fullo.

SLU utvärderade nyligen landsbygdsprogrammet. Det vore värdefullt att via scenarier framåtsyftande och långsiktigt analysera och utvärdera de styrmedlen eftersom landsbygdsprogrammet innehåller viktiga styrmedel för de areella näringarna.

Strategiska beslut behövs inom SLU om vilka satsningar som ska göras på Foma.

B 4. Framtida utmaningar

Förutsättningar

En förutsättning för Foma är långsiktighet, det gäller såväl dataförsörjning, datahantering och kompetensförsörjning. Det kräver stabil och förutsägbar finansiering med längre perspektiv.

Centralt för Foma är tillgängliga data med känd kvalitet och angelägen strategisk kompetensförsörjning är t.ex. datainsamling, modellutveckling, statistik, databaser.

Verksamhetsidé

Verksamhetsidén tycks inte ha genomslag i Foma. En av uppgifterna för Foma är enligt verksamhetsidén att värdera problem, dock finns inget strategiskt förhållningssätt till hur denna värdering bör göras. Idag är det ad-hoc och otydligt hur och var de olika programmen väljer att dra gränsen mellan att presentera underlag och att värdera underlag. Detta bör förtydligas. SLU har en unik möjlighet att koppla ihop Foma med pågående forskning inom främst jordbruks- och skogsbruksområdet. Det krävs en analys av var målkonflikter finns och en avvägning mellan aktuella frågeställningar och sådana som kan förutses på längre sikt.

Naturrekursperspektivet bör vara tydligt och andra aspekter beaktas tillsammans med miljöaspekterna t.ex. produktionsaspekter, klimat, rekreation.

Det är angeläget att lyfta in europeiska och internationella processer och problem som kan komma att påverka förutsättningarna för svenskt agerande.

Tydligare ledning.

För oss är en hel del oklart vad gäller ledning och styrning av Foma. Vem har ansvaret? Var fattas besluten? Hur kommer idéerna fram? Hur sker prioriteringar? Hur får man en samlad organisation för att ta fram idéer som kan utnyttja SLU:s totala kompetens? Hur kommer avnämarna in? Även om det finns en del sagt och skrivet om detta verkar det inte nått fram till avnämarna eller berörda inom organisationen.

Programkoordinators roll och mandat behöver stärkas. De bör ha mandat att leda programmen och ha tydliga rapporteringsvägar vid eventuella problem eller behov av justeringar av verksamheten.

Breddad omvärldsanalys

Verksamhetsidéen verkar död. För prioritering och fokusering av Foma behövs en kritisk granskning av pågående verksamhet utgående från en breddad omvärldsanalys.

Identifiera viktiga politiska processer där underlag kan behövas. Angelägna problemområden och frågeställningar bör diskuteras tillsammans med intressenter och mot bakgrund av internationella och nationella processer som kan påverka behovet av underlag från Foma.

Struktur och arbetssätt

Foma är en matrisverksamhet som behöver stöd i den strikta linjeorganisationen vid SLU. Det gäller att bryta stuprören, samordna kompetenser och bilda större grupper (t.ex. genom att klustra nuvarande program).

Foma bör arbeta för effektiva helhetslösningar. Utveckling av modeller och samspelet av modeller och datainsamling ska vara en självklar del av verksamheten. Fokus för verksamheten bör vara att ta fram så fullgott beslutsunderlag som möjligt. Det innebär en förstärkning av analysfunktionen, som utgår från en helhetssyn på ekosystemförvaltning. Värdera problem och utveckla former för värderingen tillsammans med intressenterna. Vad som är en "lämplig värdering" kan variera beroende på frågeställning och beslutssituation. Alternativa lösningar bör beskrivas och konsekvensanalyseras.

Miljömålen är en bra grund för strukturering av Foma men underlag för beslut behövs för bredare (målövergripande) områden och inom processer som idag inte självklart lyfts fram i miljömålstrukturen, t.ex. uthållighetsfrågorna, landskapskonventionen, klimatmålen och energipolitiken.

Gör programutlysningar inom vissa ramar. Låt intressenterna ha inflytande på programförklaringarna inkl utformningen av de produkter som programmet ska leverera. Verksamhetsidéen bör påverka prioriteringar.

De underlag som tas fram måste förpackas så de blir användbara för intressenterna. Upprätta kommunikationsplaner för programmen. Använd ny teknik och nya produkter för att sprida information. Informationen måste anpassas för olika grupper exempelvis i val av språk.

Utnyttja och delta i redan befintliga nätverk för informationsspridning. Inom

jordbruksdepartementet och dess myndigheter finns t.ex. ett analysnätverk som hittills inte har inkluderat Foma.

Karriär

Skapa ett karriärsystem som fungerar så att det går att behålla nyckelpersonal så att det kan bli en högt prioriterad verksamhet inom universitetet.

Ambassadörer för Foma inom SLU behövs. Ambassadörerna behöver god kännedom om de datalager som SLU ansvarar för och kunna se potentialen i att analysera dessa data för att ta fram beslutsunderlag för aktuella frågeställningar.

C. Övriga synpunkter

En stor del av panelens diskussion har gällt styrningen av verksamhetsgrenen Foma. Vi har inte förstått hur förstått hur prioriteringarna görs mellan de ingående programmen och hur arbetet leds. Vi anser ansvar och befogenheter/mandat skall höra ihop och att ledningsstruktur och prioriteringar därför måste bli tydligare.

Vårt förslag är att det inrättas en *beslutande styrgrupp* där övergripande medelstilledare och ansvariga över Fomas program och uppföljning ingår. Vicerektor för Foma ska vara underställd styrgruppen. Koordinatorerna ska i sin tur vara underställda vicerektorn och har tydliga mandat och beslutsroller. Dessutom bör det finnas en *aktiv rådgivande grupp* bestående av en vid grupp av intressenter, NGO och sektorsföreträdare.

Panelen anser också att SLU bör stå för en viss stabil basfinansiering så att alla program får en kritisk massa.

B 1

Template for UoA's self-assessments

Section A. Strategic analysis by the UoA – Research ³

Introduction

Part A of this document is designed to *help the UoA to reflect on the present and future status of their work*, and to develop and to communicate a common research strategy that meets the objectives of high scientific quality and, where appropriate, relevance for the development of industry and society in general. The information given in Section A should relate to the data given in Section C of this document.

The maximum size for *the entire section* (A1-A5) is set according to the size of the UoA:

< 6 researchers	6 A4 pages (Times New Roman, 12 p)
6-20 researchers	7 A4 pages
> 20 researchers	8 A4 pages

including the questions/instructions. *Please note that excess information will be deleted!*

A1. Mission of the UoA and Summary of present research activities

Describe the mission of the UoA. Give a summary of the current research activities including interdisciplinary aspects and important academic, industrial and societal networks.

Analyse the research environment in terms of suitability of present organisational placement within SLU, access to infrastructure and facilities within the university (cf. section C 2).

(the frame will adapt its size to the text entered)

A2. Scientific Quality

Scientific quality is characterized by original ideas, state-of-the-art methods, high productivity and prominence in advancing knowledge within the research field. The UoA is asked to make a brief analysis of their present standing by answering the following questions:

i) What are the most important scientific achievements/breakthroughs of the UoA during the last 5 years (2004-2008)?

ii) Which research institutions are suitable for benchmarking of the UoA, i.e. which research groups, etc., national or international, does the UoA compare itself with? How does the UoA perceive their own ranking compared to these?

iii) What is the 'niche' of the UoA in the global research arena, i.e. what distinguishes the UoA's research from other groups in this scientific field?

iv) What are the weak points of the UoA?

v) What are the most important obstacles for further successful development?

³ Includes curiosity-driven and needs-driven research, as well as artistic development undertaken by UoAs within landscape architecture

A3. Recognition and Leadership

Recognition and leadership is characterized by the ability of the UoA to create a successful research environment that receives attention from the scientific society, as well as society in general.

- i) Describe the most important measures taken during recent years to promote an attractive and creative research environment.

- ii) How does the UoA promote PhD education and encourage young researchers to qualify as Senior Research Fellow/Associate Professor ("docentkompetens").

A4. Relevance and Impact

Relevance and impact is characterized by ability and potential of the UoA to contribute to development of industry and society in general.

- i) What is the present impact of the UoA on relevant sectors of society? Give examples.

- ii) Describe how the UoA views the value and importance of interactions with stakeholders in a short-term and long-term perspective. What are the benefits for the research?

- iii) Based on the present situation, describe briefly the strengths and weaknesses, respectively, regarding the UoA's contribution to development of industry and society in general. (Use key-words, max. 5 bullet-points for strengths and weaknesses, respectively)

- iv) What external factors (circumstances, activities, etc. outside the UoA or SLU) does the UoA regard as opportunities, and threats, respectively. (Use key-words, max. 5 bullet-points for each aspect)

A5. Strategy and Potential

- i) Describe the UoA's goals and strategy for the next 5 years (2009-2013), including national and international collaboration and interactions with stakeholders.

- ii) What are the most promising future research directions for contributing to the advancement of knowledge within the research field (as seen from an international perspective)?

- iii) What are the most important future activities for contributing to development of society?

- iv) What conditions are required for successful implementation of the strategy?

Section B. Strategic analysis by the UoA - Environmental Monitoring and Assessment ("FOMA")⁴

This section should be completed by UoAs that include FOMA activities.

As with section A, section B is designed to *help the UoA to reflect on the present and future status of their work*, and to develop and to communicate a common strategy that meets the goal of high quality and relevance for fulfilling environmental objectives. The information given in Section B should relate to the data given in Section C of this document.

The maximum size for *the entire section (B1-B5)* is dependent on the volume of FOMA activities:

- ≤ 6 staff engaged in FOMA 6 A4 pages (Times New Roman, 12 p)
- > 6 staff engaged in FOMA 7 A4 pages

including the questions/instructions. *Please note that excess information will be deleted!*

B1. Summary of present FOMA activities

Give a summary of the current environmental monitoring and assessment activities of the UoA, including substantial SLU-internal collaboration and links to national and international organisations. Describe synergies between research and environmental monitoring.

Describe the environment in terms of organisational placement within SLU, and access to infrastructure and other facilities within the university. Also describe to which of SLU's FOMA programmes the activities belong.

B2. FOMA Quality

Quality of environmental monitoring and assessment is characterised by timely delivery of reports, information, etc. that are relevant and easily understood by decision makers. Further, the information must be reliable and thus methods that are scientifically well underpinned should be used. Regular quality checks and proper procedures for laboratory work, maintenance of large data bases, etc., are important.

The UoA is asked to make a brief analysis of its present standing by answering the following questions:

- i) Which are the most important FOMA results delivered by the UoA during the last 5 years (2004-2008)?

- ii) Which organisations/groups in Sweden and internationally are suitable for benchmarking of the UoA? What is the position, in terms of quality of FOMA activities, of the UoA in relation to these organisations/groups? (If no similar groups exist, a general description of the quality of the FOMA work should be given)

- iii) What are the weak points of the UoA?

- iv) What are the most important obstacles for successful further development?

⁴ SLU:s verksamhetsgren Fortlöpande miljöanalys

B3. Recognition and Leadership

Recognition and leadership is characterized by the ability of the UoA to create a successful environment that receives attention from the monitoring/assessment society and the main stakeholders.

- i) Describe the most important measures taken during recent years to promote an attractive and creative working environment.

B4. Relevance and Impact

Relevance and impact is characterized by ability and potential of the UoA to contribute to fulfilling local, national and international environmental objectives as well as sustainable use of natural resources.

- i) What is the present impact of the UoA on relevant sectors of society? Give examples.

- ii) Describe how the UoA views and values the importance of interactions with stakeholders in a short-term and long-term perspective. What are the benefits for FOMA activities?

- iii) Based on the present situation, describe briefly the strengths and weaknesses, respectively, regarding the UoA's contribution to fulfilling local, national, and international environmental objectives as well as sustainable use of natural resources. (Use key-words, max. 5 bullet-points for strengths and weaknesses, respectively)

- iv) What external factors (circumstances, activities, etc. outside the UoA or SLU) does the UoA regard as opportunities, and threats, respectively (Use key-words, max. 5 bullet-points for strengths and weaknesses, respectively)

B5. Strategy and Potential

- i) Describe the UoA's *goals* and *strategy* for the next 5 years (2009-2013), including national and international collaboration, and interactions with stakeholders and with research.

- ii) What are the most promising future directions of advancement?

- iii) What are the most important future activities for contributing to fulfilling stakeholder needs?

- iv) What conditions are required for successful implementation of the strategy?

Section C. Figures and Facts

C 1. UoA Staff list

A list of the UoA's staff with complete information will be provided by Uadm⁵ in January.

A preliminary list of the UoA:s staff is available on <http://kon.adm.slu.se>⁶

Name	Position ⁷	Comment (seconded, emeritus, etc.)	Also active in FOMA ⁸	Employed at SLU year

⁵ University Administration ("Ledningskansliet")

⁶ Se rubriken 'Självvärderingar'

⁷ Professor; Senior Lecturer (lektor); Senior Researcher (forskare); Junior Research Fellow (forskarassistent); Lecturer (adjunkt); Postdoc; PhD student; Technician (teknisk el. laborativ personal) (Anm: kategorier enl. personalregistret; översättning enl. VRs ordbok); Emeritus; Seconded (adjungerad)

⁸ Environmental Monitoring and Assessment

C 2. Research environment and infrastructure

Description of the environment

Here the UoA should describe available resources in terms of infrastructure, as well as their links with other organizational units, e.g.:

- Access to specialized equipment and other important research facilities;
- Access to technical staff (in addition to those included in the UoA);
- Other relevant competence at the Department, or if applicable, the Centre to which the UoA belongs;
- Important collaborations within SLU or with other neighbouring research institutions (e.g. Lund University, Uppsala University, Umeå University, SVA, JTI)

(the description should not exceed this frame)

C 3. Quantitative Data of the UoA

Standardized operational data will be provided by Uadm in January-February.

a) Staff Profile (2008)

Category	Total no. of persons	FTE # in total (%)	FTE – Women (%)	FTE – Men (%)	FTE in Research (%)	FTE in FOMA (%)	FTE in teaching (%)	Share with "Docent" competence" (%) §	Share with <5 years to retirement (%)
Professors									
Senior Staff*									
Junior Staff **									
PhD students									
Other ***									

* Senior Lecturers, Senior Researchers; ** Junior Research Fellows, Postdocs; *** e.g. Lecturers, ("adjunkter"), Technicians; # Full time equivalents; § Qualification as Research Fellow

b) Funding profile - Research

Source	Volume (MSEK)	2006	2007	2008
External Grants ("uppdrag" och "bidrag")				
Research Councils incl. Vinnova				
Research Foundations (SSF, Mistra, KK)				
Research Foundations (KAW, SLF, Tryggers, etc.)				
EU and other international				
Swedish Public authorities (myndigheter, kommuner, landsting)				
Industry (Swedish or international)				
In total				
Government Grant/Appropriation ("statsanslag")				
Total volume				
External Funding ratio (%)				

Note: Corresponding information will also be given for FOMA

c) Publication profile

Total number of publications with UoA researchers as (co)authors

	2008	2007	2006	2005	2004
Scientific papers (peer-reviewed)					
Book chapters					
Books					
Reports					
Conference/proceedings					
Dissertations					
Fact sheets ("faktablad")					
Articles in daily newspapers					
Articles in popular science magazines					

For full bibliometric data on scientific publications during 1998-2008, see separate report

Note: SLU Libraries will produce statistics based on **the publication data registered by the UoA's researchers**. Please note that the deadline for entering data in Phase 2 and Phase 3 is **Friday 30 January 2009**.

C 4. Activities and Outputs

The indicators in this section, together with sections A, B, and D, are chosen to provide a foundation for the Scientific Panels' evaluation of the UoA. Criteria for the Scientific evaluation are Scientific Quality; Recognition and Leadership; Relevance and Impact; and Strategy and Potential. Some of the data will also be used in the separate Impact evaluation.

*UoAs are asked to fill in **relevant parts** of sections C 4.1 – 4.5. Please note that:*

- Data should refer to the period 2004-2008, unless otherwise stated;
- In some cases the UoA is asked to enter a **limited number of examples**; here, the UoA should select items that they consider to be of major importance (in order of priority), or items that best reflect the UoA's span of activities;
- Data referring to **FOMA** should be entered where appropriate (such items should be indicated with an "F");
- The entire section C 4.1 – 4.5 must not exceed **10 pages**. Any information in excess of the given limits will be **deleted**.

C 4.1 Research Activities and Outputs

Major competitive, ongoing grants from Swedish, European or other international research funding agencies⁹

Select the most important (maximum 5; 8 if the UoA has >20 researchers¹⁰).

If needed, consult the list of contracts that will be provided by Uadm on <http://kon.adm.slu.se>

Funding source	Project title	Duration (20xx-20xx)	Total volume (MSEK)
		-	
		-	
		-	
		-	
		-	

Major national and international scientific collaborations during 2004-2008

Select the most important (maximum 5; 8 if the UoA has >20 researchers)

Title	Nature (Centre of Excellence, network, graduate school, etc.)	Role of UoA (coordinator, partner, etc.)	Duration (20xx-20xx)
			-
			-
			-
			-
			-

⁹ Organisations with research funding as their primary task, using peer-review selection processes, i.e. Research Councils (VR, Formas, FAS, Vinnova), Research Foundations (e.g. MISTRA, SSF; SLF); EU Framework Programme or other programmes, ESF, etc.

¹⁰ See "UoA Size" in the table on page 1

PhD and Licentiate degrees awarded during 1998-2008

N.B. with researcher at the UoA as main supervisor ("huvudhandledare")

	Total	Women	Men		Total	Women	Men
PhD				Licentiate ¹¹			

Career of former PhD/Licentiate Students with degrees awarded 1998-2008,

Number of persons grouped by their *present* employer:

SLU	Other Swedish HEI ¹²	HEI abroad	Research institutes	Industry	Public authority	Self-employed	Other/Unknown

Major scientific publications during 2004-2008

Select the most important (maximum 5; 10 if the UoA has >20 researchers).

Indicate authors at UoA in bold.

Author(s) /Year of publication /Title of paper /Journal name, volume, issue, pages

Scientific conferences during 2004-2008

	International	National
Number of invitations as speaker		
Number of conferences arranged with UoA researchers as principal organisers		

C 4.2. Awards, Assignments, etc.

National and/or international commissions¹³ during 2004-2008

Select the most important (maximum 5; 8 if the UoA has >20 researchers)

Name of researcher	Name and type of organization	Nature of the assignment	Duration (20xx-20xx)
			-
			-
			-
			-
			-

¹¹ Licentiates =only persons not awarded PhD degrees

¹² HEI= Higher Education Institutions, i.e. universities and colleges

¹³ Commissions in boards, committees, expert panels, advisory groups, etc.

Major awards and prizes during 2004-2008

Select the most important, (maximum 5)

Name of researcher	Awarding organization; name of award

Academy fellowships, memberships in learned societies, etc., during 2004-2008

Select the most important, (maximum 5)

Name of researcher	Organization; description

Assignments as external examiner (“opponent”) at PhD dissertations during 2004-2008

Number of national assignments:		Number of international assignments:	
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C 4.3. Interaction with society

Major ongoing contracts with public authorities, industry or other organisations (Swedish or international)¹⁴

Select the most important (maximum 5; 8 if the UoA has >20 researchers).

If needed, consult the list of contracts that will be provided by Uadm on <http://kon.adm.slu.se>

Funding source	Project title, etc.	Duration (20xx-20xx)	Total volume (MSEK)
		-	
		-	
		-	
		-	
		-	

¹⁴ activities that generate income, e.g. collaborative research programmes with non-academic partners, commissioned education (“uppdragsutbildning”)

Support for policy- and decision-making processes by governmental, international or non-governmental organizations during 2004-2008 ¹⁵

Select the most important (maximum 5)

Output/assignment	Target organization (name and type)	Nature of the output/assignment

Other interactions with public or private stakeholders during 2004-2008

Number of seconded (“adjungerade”) Professors/Associate Professors	
Number of PhD students whose salary is paid by industry, institutes, etc.	
Other types of interaction with stakeholders)	

Commitments to collaboration with developing countries during 2004-2008

Select the most important (maximum 5)

Nature of collaboration	Partners (organizations, country/ies, etc.)	Duration (xxxx-20xx)
		-
		-
		-
		-
		-

Web sites or web-based services made available to users outside SLU during 2004-2008

Select the most important (maximum 5)

Name of product; function	Target group	Approx. no. of users per year

¹⁵ e.g. commissions of inquiry (“utredningar”), external consultancies, data compilations, analyses.

Outreach activities and outputs during 2004-2008¹⁶

Select the most important (maximum 5; 8 if the UoA has >20 researchers).

Type of activity/output	Target group	Volume ¹⁷

Intellectual property and innovation activities developed through the UoA's research during 2004-2008

Number of patents awarded and submitted, respectively		
Number of licenses		
Number of spin-offs or other companies		
Number of released plant cultivars		
Software		

C 4.4. Renewal**Recruitment during 2004-2008**

Number of persons ¹⁸	University where PhD degree was awarded		
	SLU	Other Swedish HEI	HEI abroad
Professors	()	()	()
Other research staff ¹⁹	()	()	()

Exchange of researchers during 2004-2008

	Number of visits
Visiting researchers: At least 1 months' duration	
Visiting researchers: Shorter duration (only if recurrent, long-term collaboration)	
Research visits abroad: At least 1 months' duration	
Research visits abroad: Shorter duration (only if recurrent, long-term collaboration)	

PhD education during 2004-2008

Number of PhD courses with UoA researchers as principal or co-organiser ²⁰	
Number (approx.) of invited speakers at open scientific seminars, etc.	

¹⁶ e.g. communication of research results in media, popular publications, conferences or other events

¹⁷ e.g. no. of participants

¹⁸ The number of persons that are also active in FOMA should be indicated in brackets

¹⁹ Staff with PhD degree: Senior Lecturers ("lektor"); Senior Researchers ("forskare"); Junior Research Fellows ("forskarassistent"); Postdocs;

²⁰ If needed, consult the list of PhD courses at department level provided by Uadm on <http://kon.adm.slu.se>

C 4.5 Activities and outputs not covered by C 4.1 – C 4.4

The UoA may enter any information considered as relevant for the evaluation.

(the description should not exceed this frame)

D. Other factors for the Expert Panel to consider

Briefly describe circumstances that may affect the UoA's performance in KoN, e.g. recent retirement of a senior researcher, recent reorganisation, faculty assignments, etc.

(the description should not exceed this frame)

B 2

KoN performance indicators
(description of bibliometric analysis)

REPORT TO PANELS ON PERFORMANCE INDICATORS

Bibliometric indicators are based on a quantitative analysis of scientific papers in international journals and serials processed for the Web of Science (WoS) versions of the Citation Indices (SCI, SSCI and A&HCI). Today Web of Science covers more than 10 000 journals. As a complementary analysis we have used other scientific publication channels, i.e. books, edited books and articles in academic, refereed journals (according to Ulrich's periodicals directory there are 30 000 journals and serials) not indexed in the WoS database. Together these methods should make it possible to account for different aspects of research group performance at SLU.

The key consideration that has guided the approach taken here is a requirement to make use of multiple indicators in order to better describe the complex patterns of publications at a research university. The study makes use of several methods, each deepening the understanding of a UoA's publication output from a different angle of incidence. No single indices should be considered in isolation.

Publications and citations form the basis of the indicators used. Citations are a direct measure of impact but they measure the quality of an article only indirectly and imperfectly. Whilst we can undoubtedly measure the impact of a research unit by looking at the number of times its publications have been cited, there are limitations. Citation-based methods enable us to identify excellence in research, however these methods cannot, with certainty, identify the absence of excellence (or quality).

Impact measures

International scientific influence (impact) is an often used parameter in assessments of research performance. Impact on the research of others can be considered as an important and measurable aspect of scientific quality, but of course, not the only one. Within most international bibliometric analyses there are a series of basic indicators that are widely accepted.

Data is confined to **articles, letters, proceeding papers and reviews** (WoS-papers) in refereed scientific journals. The question arises whether a person who has published more papers than his or her colleagues has necessarily made a greater contribution to the research front in that field. All areas of research have their own institutional "rules", e.g. the rejection rate of manuscripts differs between disciplines: while some areas accept 30–40 per cent of submitted manuscripts due to perceived quality and space shortages, other areas can accept up to 80–90 per cent. Therefore, a differentiation between *quantity* of production and *quality* (impact) of production has to be established. Several bibliometric indicators are relevant in a study of "academic impact" – the number of citations received by the papers, as well as various influence and impact indicators based on field-normalized citation rates. Accordingly, we will not use the number of papers as an indi-

cator of performance, but we have to keep in mind that fewer papers indicates a low general impact, while a high number of cited papers indicates a higher total impact.

“Brain power” of research units

KON bibliometrics focus on the *brain power* (also called the “back-to-the-future or *prospective* approach)¹ of the research personnel employed by SLU at the end of year 2008. Regardless of where individuals were employed before being hired by SLU, all of their publications are counted for the whole evaluation period (1998–2008). Consequently, it is impossible to use the number of papers as an informative indicator when relating to the input indicators for SLU departments or research units. Instead, we use relative bibliometric indicators which set the citation counts in relation to the global journal average and the global field average.

Validation of bibliographic data

Constructing a validated bibliography for each Unit of Assessment’s production is an issue of outmost importance. The identification of papers included in the exercise has been performed *by the researchers themselves* in a procedure of uploading WoS-data to a SLU database. This procedure was organized by the SLU library unit. All researchers have been given the opportunity to check that their publication data are correct and complete. The bibliometric analysis, therefore, is based on data yielded in a process of researcher validated data. After a first analysis the result was distributed to each UoA and researchers were given the opportunity to validate (again) and discuss the material. Unfortunately, some of the research staff (approx. 10 %) had not uploaded WoS-data and their files had to be completed by the analysts.

Coverage issues

The Web of Science works well and covers most of the relevant information in a large majority of the natural sciences and medical fields, and also works quite well in applied research fields and behavioral sciences.² However, there are exceptions to that rule. Considerable parts of the social sciences and large parts of the humanities are either not very well covered in the Web of Science or have citations patterns that do not apply to studies based on advanced bibliometrics.³ This is the basic argument for using complementary bibliometric methods in this evaluation.

Matching of references to articles

The Thomson Reuters database consists of articles and their references. Citation indexing is the result of a linking between references and source (journals covered in the data-

¹ Visser & Nederhof (2007), p. 472.

² CWTS (2007) p.13.

³ Butler, 2008; Hicks, 1999; Hicks, 2004.³

base). This linking is done with a citation algorithm but the one used by Thomson Reuters is conservative and as a consequence non-matching between reference and article is not uncommon.⁴ Therefore, in the KON analysis, we have used an alternative algorithm that addresses a larger number of the missing links. Additionally, we have corrected links to SLU papers using a manual double-check. This should account for most of the 'missing' citations.

Self-citations

Self-citations can be defined in several ways, usually with a focus on co-occurrence of authors or institutions in the citing and cited publications. In this report we follow the recommendation to eliminate citations where the first-author coincides between citing and cited documents). If an author's name can be found at other positions, as last author or middle author, it will not count as a self-citation. This more limited approach is applied for one reason: if the whole list of authors is used, the risk for eliminating the wrong citations is increased. On the down-side, this method may result in a senior-bias. This will probably not affect Units of Assessment, but caution is needed in analysis at the individual level.⁵

Time window for citations

An important factor that has to be accounted for is the time effect of citations. Citations accumulate over time, and citation data has to cover comparable time periods (and be within the same subfield or area of science, see below). However, in addition to that, the time patterns of citation are far from uniform, and any valid evaluative indicator must use a fixed window or a time frame that is equal for all papers. The reason for this is that citations have to be appropriately normalized. Most of our investigations use a decreasing time-window from the year of publication until December 31 2008.

Fractional counts and whole counts

The high frequency of scientific collaborations makes it necessary to differentiate between whole counts and fractional counts of papers and citations. By dividing the number of authors from the group with the number of all authors on a paper we introduce a fractional counting procedure. Fractions of papers are used as weights in the citation analysis.

Fields and sub-fields

In bibliometric studies, the definition of fields is generally based on the classification of scientific journals into the 250 or so categories developed by Thomson Reuters. Although this classification is not perfect, it provides a clear and consistent definition of

⁴ Moed HF, van Leeuwen TN (1995).

⁵ Adams, 2007: 23; Aksnes, 2003a Aksnes, 2003b; Glänzel et al., 2004; Thijs & Glänzel, 2005.

fields suitable for automated procedures. However, the classification of journals includes one sub-field category named “Multidisciplinary Sciences” for journals like *PNAS*, *Nature and Science*. More than 50 journals are classified as multidisciplinary since they publish research reports in many different fields. Fortunately, each of the papers published in this category are subject-specific, and therefore it is possible to assign a subject category to these on the article level – what has been called an “*item by item reclassification*”.⁶ We have followed that strategy in our analysis of SLU units.

Normalized indicators

The normalization procedure shown in Figure 1 can be further explained thus: The sub-field consists of five journals (A–E). For each of these journals, a journal-based reference value can be calculated. This is the journal mean citation level for the year and document type under investigation. The UoA might have a CPP (Citation per Paper) above, below or on par with this mean level. All journals in the sub-field are taken together as the basis for the field reference value. A researcher publishing in journal A will probably find it easier to reach the mean than a researcher publishing in journal E.

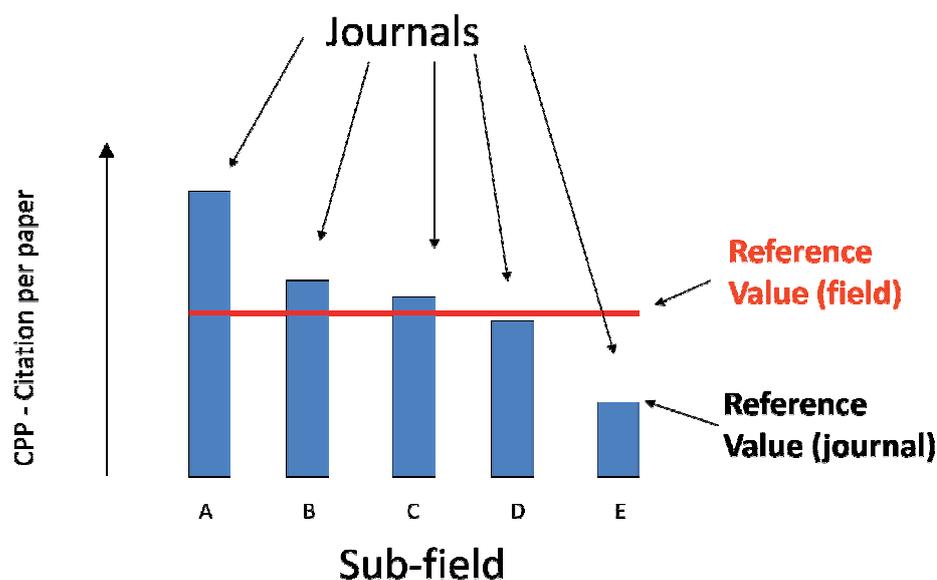


Figure 1. Normalization of reference values.

We consider the field citation score to be the most important indicator. The number of citations per paper is then compared with a sub-field reference value. With this indicator it is possible to classify UoA performances in five different classes:⁷

⁶ Glänzel et al. (1999).

⁷ This classification of performances is inspired from presentations made by van Raan (2004), but the levels are accommodated to the methods used for computation of KON citation scores. CWTS levels are higher as citations are not fractionalized.

A. $NCSf \leq 0.60$	significantly far below international average
B. $0.60 < NCSf \leq 1.20$	at international average
C. $1.20 < NCSf \leq 1.80$	significantly above international average
D. $1.80 < NCSf \leq 2.40$	from an international perspective very strong
E. $NCSf > 2.40$	global excellence

How many papers is needed in order to have statistically significant results? At least 30 papers are needed to be able to check the significance and a variation of 5-10 % is quite expected.⁸ In the bibliometric profile we present results as deciles of SLU performance (see below).

Top 5 percent

The above field normalized measures gives a quite complete picture, but, still, we might need simple figures that indicate the excellence of the group in just one number and the *Top5%* is an indicator of that type. As an indicator it expresses the share of publications within the top 5% of the worldwide citation distribution of the fields concerned for the given research group. This approach provides a better statistical measure than those based on mean values.⁹ We suggest that this indicator is used together with other indicators and in this case as “*a powerful tool in monitoring trends in the position of research institutions and groups within the top of their field internationally*”.¹⁰ If the research group has a high proportion of articles in the *Top5%* they will probably have a large impact on colleagues in their research field.

h index

The *h* index is a method that combines two different factors: 1) the number of articles and 2) the number of citations. A scientist is said to have Hirsch index *h* if *h* of their *N* papers have at least *h* citations each, and the remaining (*N-h*) papers have fewer than *h* citations.¹¹ The *h*-index measure is easy to compute and is nowadays included in the Web of Science and the Scopus databases as a quick and straightforward yardstick (Lehmann et al., 2006). The fractionalized *h*-indicator is named *hf*-index.

The aim of the *h* index to measure the cumulative impact of a researcher's output by looking at the amount of citation his/her work has received. The advantage of the *h*-index is that it combines an assessment of both quantity (number of papers) and quality (impact, or citations to these papers) (Glänzel, 2006). A researcher cannot have a high *h*-index without publishing a substantial number of papers. However, this is not enough. These papers need to be cited by other academics in order to count for the *h*-index.

⁸ Schubert A & Glänzel W (1983).

⁹ See contributions by PO Seglen (1988, 1992, 1997).

¹⁰ CWTS, 2007: 25

¹¹ Hirsch, 2005: 16569. The properties of the *h*-index have been analyzed in various papers; see for example Leo Egghe and Ronald Rousseau: An informetric model for the Hirsch-index, *Scientometrics*, Vol. 69, No. 1 (2006), pp. 121-129.

There are several problems and biases connected to the h-index. The balance between younger and older researchers is an obvious example. Caution is needed especially when the h-index is to be applied in research assessments where there are several research areas covered. As pointed out by many observers, there are huge differences in the number of articles produced by a “normal” author depending on his or her discipline. Regardless of that we have decided to include the h-index in our results but with an awareness of the biases in the measure. Nonetheless, we consider the h-index as an important indicator for comparing *individuals* within the same fields. Apparently, the indicator provides an index for research impact and as such it has met a lot of interest from the scientific community.¹²

Scaled hf-index

The g-index was proposed by in 2006¹³ with the following definition: “[Given a set of articles] ranked in decreasing order of the number of citations that they received, the g-index is the (unique) largest number such that the top g articles received (together) at least g^2 citations.” Obviously, the aim of the g-index is to improve on the h-index by giving more weight to highly-cited articles. As a consequence a research unit with a comparably high g-index will report a high number of rather important research papers.

In order to meet the requirements posed by the field normalized citations measures a scaling of the h-index has recently been proposed.¹⁴ Based on the average number of citations within each of twenty-two ISI fields a factor (a quotient) is generated between fields. The normalizing factor (f_i) is the value by which the h index in one specific field has to be multiplied in order to put it on the same scale as the reference fields (Physics). The operation of h times f_i gives the *H*-index, therefore our scaled indicator, for which we use the usual fractionalization, is given the abbreviation *Hf*-index.

Publication Points (Phase II) per researcher

The second phase of the *Quality and Impact* (KON) bibliometric evaluation concerned a monitoring and assessment of all scientific publications no matter if these publications were available in the Web of Science database or not. In order to have a more complete picture of scientific publishing at the SLU Phase 2 utilized bibliographical data from sources with a wider coverage of the scientific literature and did also allow manual input of data.

To be more precise, Phase 2 consisted of an author search in one or more of three databases within the portal Web of Knowledge (WoK), which includes several databases such as CAB Abstracts, BIOSIS Previews and FSTA. Phase 2 (like Phase 1) was solely concerned with scientific publications i.e. refereed journals or books or contributions to anthologies published by scientific publishers with external referee procedures. By using

¹² See Bornmann & Daniel (2009); Bornmann, Marx, Schier (2009); Iglesias & Pecharrroman (2007).

¹³ Leo Egghe: Theory and practice of the g-index, *Scientometrics*, Vol. 69, No 1 (2006), pp. 131-152.

¹⁴ Iglesias & Pecharrroman: Scaling the h-index for different scientific ISI fields, *Scientometrics*, Vol 73, No 3 (2007), pp. 303–320.

an authority register of publication channels and publication types developed by a Norwegian academic committee (organized by the UHR) for the performance-based redistribution of funding from the Ministry of Education set in motion since 2006. The register of academic publication journals has been enlarged with all academic, peer reviewed journals in the Ulrich's Periodicals database (as of October 5, 2008). In total, the registry contains information on the standardized name and number (ISSN, ISBN) of 30 958 periodicals and series and 982 publishers.¹⁵

As indicated there are three academic publication types identified by the Academic Committee:

- monograph
- article in an anthology
- article (plus *letter, review and proceedings paper*) in a periodical or series.

Counted as *research* in the model are publications that meet the following requirements. Publications should:

1. *present new insight (originality);*
2. *be presented in a form that allows the research findings to be verified and/or used in new research activity;*
3. *be written in a language and have a distribution that make the publication accessible to most interested researchers;*
4. *appear in a publication channel (journal, series, book publisher, website) that has routines for external peer review.*¹⁶

An academic publication channel must have an editorial unit that arranges for external peer review. That applies for publishing houses as well as journals. Channels can also be classified according to whether they have local, national or international circuit of authors. Authorship has been given the following operational definition:

- *Authorship is local when more than two-thirds of the authors published in the channel are from the same institution.*
- *Authorship is national when more than two-thirds of the authors published in the channel are from the same country.*
- *Authorship is international when less than two-thirds of the authors published in the channel are from the same country and the channel uses an international language.*

In principal, only those channels that have a national or international circuit of authors are considered in Phase II.¹⁷

Another feature of the “Norwegian model” is classification of channels into two different quality levels. Higher weight is given to approximately 20 % of the most prestigious publication channels according to the following:

Table 1. Weighting of publication types for the two levels of publication channels

Publication type	Level 1	Level2
<i>Article in periodical/serial</i>	<i>1</i>	<i>3</i>
<i>Monograph</i>	<i>5</i>	<i>8</i>
<i>Article in anthology</i>	<i>0.7</i>	<i>1</i>

¹⁵ Of which WoS=10 580, Norwegian=10 385, and Ulrich's 9 977. Within the Norwegian system most WoS is covered.

¹⁶ A bibliometric model for performance-based budgeting or research institutions. UHR website <www.uhr.no>

¹⁷ It should be pointed out that the registry of publishing houses contains a number of local channels.

The calculation of publication points is based on the number of authors of the publication according to the following formula for fractionalization:

- A publication with 1 author is worth 1 point.
- A publication with n authors is worth $1/n$ point for each author, but the value must be at least $1/10$ point (fractions are not used when there are more than ten authors).

Editors are not credited with points in this system and textbooks are not regarded as academic monographs. Furthermore, any foreword, summary, discussion or other editorial material is not included in the definition of academic publications. The same applies for contributions to encyclopedias (or equivalent), book reviews, erratum, obituaries, biographical items, corrections, meeting abstracts, meeting posters, news items and reprints. Important is that an author can only be credited once for a publication. Consequently, if a conference proceedings paper later is published as an article it will not count. In summary, the model is quite laborious.

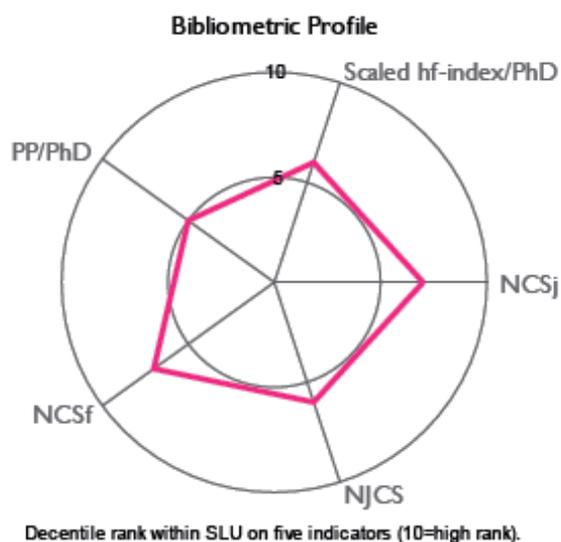
The publications points per year produced by all members of the unit are divided with the number of personnel with a PhD. Points are calculated per year and the average per year over the time period (2004–2008) is the final result. Each personnel are counted as a full-time contributor, but as we know there are important differences between units depending on their involvement in undergraduate teaching. There is information given in the self-evaluation reports that gives the time used for research per personnel category (FTE). In the bibliometric report we have confined ourselves to counting of persons holding a PhD as we use output data for a five year period and a “brain power”-approach. FTE for research would be quite unstable. Panel members have access to data and can draw their own conclusions on whether the figure for publication points should be corrected or not.

Bibliometric Profile (figure in pdf)

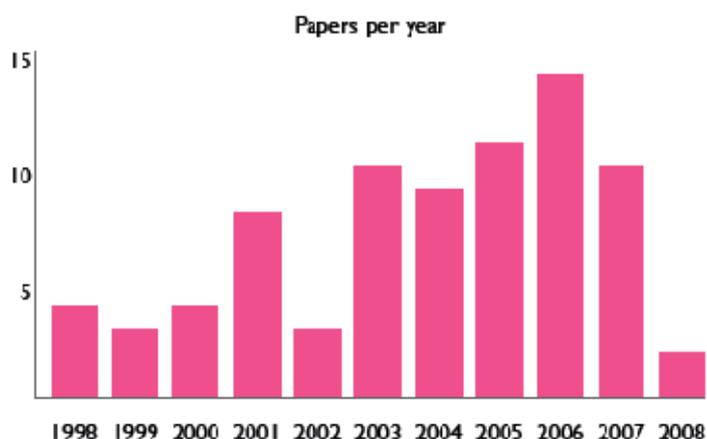
Bibliometric results are described in the “bibliometric profile” given in the UOA bibliometric Indicator report (see Figure 1). The profile is based on a selection with the three field normalized indicators, the scaled hf -index and the Publications Points per researcher indicator. NCS_f , NCS_j and $NJCS$ are citation based indicators. Scaled hf -index and PP/PhD are taking the production of papers into account.

Values are shown as a position transformed to decentiles within the SLU distribution on each performance indicator. The position of 5 indicates a SLU-normal performance and 10 is at the top of SLU-performance. We have chosen to illustrate the profile with a polar diagram. Figure 1 would be interpreted as a group on par with the general SLU performance on several indicators, but with a better field-normalized citation score (NCS_f) than SLU in general (decile 7). Obviously they publish in better journals and have a high impact in their journal set.

Figure 1. Bibliometric Profile of UOA (example)



At the bottom to the right in the pdf-file per UOA there is a bar chart showing the number of papers per year (see Figure below). For the interpretation of the “Papers per Year” diagram it is necessary to acknowledge that the “brain power”-approach will produce certain effects. If, for example, the group has lost members of the unit during the period and has recruited younger personnel (e.g. doctoral students) instead, there will be few publications in the beginning of the period and more publications later on (2004–2008) (illustrated below).



Another question that might arise concerns the number of 2008 publications. The database covers items in the ISI-database as of December 31, 2008 and the ISI continues to add posts of publications from 2008 during 2009 as journals will not have an immediate indexing. Therefore, a slight downfall for 2008 is expected. If we are looking for consistent and stable figures we should concentrate on the number of papers until 2007.

Summary of indicators

Information gathered and analyzed includes the following indicators:

Table 2: Indicators in the pdf-file

P	NUMBER OF PAPERS	Number of papers (articles, letters and reviews) published by UoA “NN” during 2000–2008.
Frac P	NUMBER OF FRACTIONALIZED PAPERS	Sum of author fractionalized papers (articles, letters and reviews) published by UoA “NN” during 2000–2008.
CPP	CITATIONS PER PAPER	Number of citations per paper (31 December 2008).
NCSj	JOURNAL NORMALIZED CITATION SCORE	CPP normalized in relation to the UoA “NN” journal set (average=1.00).
NJCS	NORMALIZED JOURNAL CITATION SCORE	The impact of the journal set normalized in relation to its sub-fields (average=1.00).
NCSf	FIELD NORMALIZED CITATION SCORE	CPP normalized in relation to the UoA “NN” sub-field set (average=1.00).
TOP5%	TOP 5%	Percentage of papers above the 95th citation percentile.
H-INDEX PER RES	H-INDEX PER RESEARCHER	h number of papers that have at least h number of citations.
HF-INDEX PER RES	FRACTIONALIZED H-INDEX PER RESEARCHER	h-index taking number of authors per paper into account.
G-INDEX	G-INDEX PER RESEARCHER	Giving higher weight to highly cited papers using the h-index methodology
SCALED HF-INDEX	SCALED HINDEX PER RESEARCHER	Normalization of the hf-index based on reference values per ISI field (22 fields)
PP/RES	PUBLICATIONS POINTS PER RESEARCHERS	Publication points according to Norwegian model per researcher holding a PhD.

Journal Normalized Citation Score (NCSj): Citations per publication related to the reference value, which in this case is the average number of citations per publication in the journals in which the UoA appears, taking document type and year of publication into account. [This indicator is almost identical to the CPP/JCS indicator developed by the Leiden group]

Normalized Journal Citation Score (NJCS): This measure is used in order to estimate the average journal impact in relation to other journals in the same sub-field(s).

[This indicator is almost identical to the JCS/FCS indicator developed by the Leiden group]

Field Normalized Citation Score (NCSf): Citation per publication related to a reference value built on the global averages for all articles in the sub-fields to which the UoA papers are assigned. [This indicator is almost identical to the CPP/FCS indicator developed by the Leiden group]

Major differences between areas of science call for an alternative measure that takes the deviation of citations into account. Since citation data are skewed we use the logarithm of citations before calculating the standard deviation. This measure is called *Standardized Citation Score, field*, SCSf, and measures the number of standard deviations from the average. This indicator is used as complementary to the NCSf.

Top 5% is measure that takes the skewed distribution of citations into account. More precisely, this indicator shows how many of the UoA papers that are above the 95th percentile regarding citations in their sub-fields.

REFERENCES

- Adams, J et al. (2007). The use of bibliometrics to measure research quality in UK higher education institutions. Universities UK, Research Report. Evidence.
<<http://www.book-shop.universitiesuk.ac.uk/downloads/bibliometrics.pdf>>
- Aksnes, DW (2003a). A macro study of self-citations. *Scientometrics* 56(2):235–246.
- Aksnes, DW (2003b). Characteristics of highly cited papers. *Research Evaluation* 12 (3): 159–170.
- Bornmann, L & Daniel HD (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation*, 64(1), 45–80.
- Butler, L (2002). A list of published papers is no measure of value. *Nature* vol 419 (31 OCTOBER).
- Butler L (2003). Explaining Australia's increased share of ISI publications – the effects of funding formula based on publication counts. *Research Policy* 32:143–155.
- Butler L (2008). Using a balanced approach to bibliometrics: quantitative performance measures in the Australian Research Quality Framework. *Ethics in Science and Environmental politics*, vol 8, preprint doi: 10.3354/esepp00077.
- CWTS (2007). Scoping study on the use of bibliometric analysis to measure the quality of research in UK higher education institutions. Report to HEFCE by the Leiden group. November 2007.
[http://www.hefce.ac.uk/pubs/rereports/2007/rd18_07/rd18_07.pdf]
- Glänzel W, Schubert A, Schoepflin U, et al. (1999). An item-by-item subject classification of papers published in journals covered by the SSCI database using reference analysis. *Scientometrics*, 46 (3): 431–441.
- Glänzel W, Thijs, B., Schlemmer, B. (2004). A bibliometric approach to the role of author self-citations in scientific communication, *Scientometrics*, 59 (1): 63–77.
- Glänzel W (2006). On the opportunities and limitations of the H-index, *Science Focus*, vol. 1 (1), pp. 10-11
- Hicks D (1999). The difficulty of achieving full coverage of international social science literature and the bibliometric consequences. *Scientometrics*, 44(2):193–215.
- Hicks D (2004). The four literatures of social science. (Eds.) Moed et. al. *Handbook of Quantitative Science and Technology Research: The use of publication and patent statistics in studies of S&T systems*. Dordrecht/Boston/London: Kluwer Academic Publishers 2004, pp. 473–496.
- Hirsch, JE (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America*, 102 (46): 16569–16572.
- Lehmann, S, Jackson, A & Laurup, BE (2006). Measures for measures. *Nature*, 444 (21/28 dDecember), pp. 1003–1004.
- Moed HF (2005). *Citation Analysis in Research Evaluation*. Dordrecht: Springer Verlag.
- Moed HF, van Leeuwen TN (1995). Improving the Accuracy of Institute for Scientific Information's Journal Impact Factors. *JASIS* 46(6):461–467
- Moed HF, Vriens M (1989). Possible inaccuracies occurring in citation analysis. *Journal of Information Science* 15:95–107.
- Moed, HF. & van Raan, A.F.J. (1988). Indicators of research performance: applications in university research policy. In: van Raan, (Ed.) *Handbook of Quantitative Studies of Science and Technology*. Amsterdam: North-Holland, pp. 177–206.
- Schubert A & Glänzel W (1983). Statistical reliability of comparisons based on the citation impact of scientific publications. *Scientometrics* 5: 59–74.
- Schubert, A. Glänzel, W. Braun, T. (1988). Against absolute methods: relative scientometric indicators and relational charts as evaluation tools. In: van Raan, (Ed.) *Handbook of Quantitative Studies of Science and Technology*. Amsterdam: North-Holland, pp. 137–176.
- Thijs B, & Glänzel W (2005). The influence of author self-citations on bibliometric meso-indicators. The case of European universities. *Scientometrics*, 66 (1): 71–80.
- van Leeuwen, TN (2008). Testing the validity of the Hirsch-index for research assessments purposes. *Research Evaluation*, 17(2):157–160.
- van Raan, AFJ (1996). Advanced bibliometric methods as quantitative core of peer review based evaluation and foresight exercises. *Scientometrics*, 36(3):397–420.
- van Raan, AFJ (2004). Measuring Science: Capita Selecta of Current Main Issues. (Eds.) Moed et. al. *Handbook of Quantitative Science and Technology Research: The use of publication and patent statistics in studies of S&T systems*. Dordrecht/Boston/London: Kluwer Academic Publishers 2004, pp.19–50
- Visser, M.S. Nederhof, A.J. (2007) Bibliometric study of the Uppsala University, Sweden, 2002–2006. In: *Quality and renewal 2007: An overall evaluation of research at Uppsala University 2006/2007*. Uppsala: Uppsala University.

B 3

Requirements for members in Scientific panels

Scientific Panels: Panel Member Requirements

Panel composition

Chairperson and 4-6 Panel Members, one of whom should be familiar with the Swedish university system.

Two additional members from industry, public authorities or other stakeholder organisations relevant to the Panel's subject field.

Required Qualifications

General requirements

The experts should have an academic background in a corresponding research field.

Preferably from a prominent scientific environment that corresponds to that which will be evaluated (i.e. have an understanding of SLU's status as a sector university).

Experts must be impartial with no economical, research associated or other significant links with the groups they will be assessing since **January 2004**. Also, impartiality due to friendship or enmity should be avoided. Exceptions from the impartiality criterion can be made in case of collaborators in large international projects, e.g. within the EU Framework Program, but will be decided on a case-to-case basis.

All central research areas within the research field in question must be represented in the panel.

An equal gender balance should be aimed at.

Chairperson

Broad background in the research field in question

Distinguished scientist with high integrity

Experience with international evaluations

Suitable for assuming chair responsibilities

Not active in Sweden

Panel Members - Scientists

Expert in at least one of the research areas central to the research field in question.

Active outside Sweden, e.g. in the Nordic countries, Europe or outside Europe.

At least 1 member (Nordic) should have experience of the research infrastructure, strategies and funding in the Swedish university system. (In certain cases, this member can be Swedish, but from another university than SLU.)

Panel Members - Stakeholders

Should have a scientific background and experience that ensures a good understanding of research within the subject field.

Should have a broad overview of the needs of industry, authorities and/or society in general within the field.

From Sweden or the Nordic countries and have good overview of the Swedish conditions within the field.

Tasks

Chairperson

Participates in the Chair's Meetings, preceding and after the panel visits.

Plans and leads the work of the panel, ensures that the entire process complies with the objectives of the evaluation.

Judges and summarizes the quality of the activities in the entire research field in question.

Offers advice to the research areas on actions required for successful development and renewal.

Responsible for submitting the Panel Report.

Panel Members - Scientists

Judges and documents the quality and relevance of the research activities of the Research Field and the Units of Assessment.

Offers advice to the research areas on actions required for successful development and renewal.

Responsible for providing input to the panel report.

Additional task of the Nordic/Swedish Panel Member

Advises the panel on the specific conditions and practices in the Swedish university system.

Panel Members - Stakeholders

Introduces a user perspective in the assessment of "Relevance and Impact", and provides input to the panel report on the parts related to Relevance and Impact.

B 4

Schedule for Scientific panels

Schedule for Scientific panels

Schedule for Registration and Introduction Monday May 4

Day	Activity	Place
Monday May 4		
08.30 - 09.00	Registration	Loftets stora sal
09.00 - 09.20	Welcome - <i>Vice-Chancellor Lisa Sennerby Forsse</i>	Loftets hörsal
09.20 - 09.50	The Quality and Impact Evaluation – <i>Director Roland von Bothmer</i>	Loftets hörsal
09.50 - 10.00	The Bibliometric Analyses – <i>Deputy Director Johan Schnürer</i>	Loftets hörsal
<i>Break</i>		
10.30 - 11.40	SLU and the Swedish University System – <i>Deputy Director Johan Schnürer</i>	Loftets stora sal Loftets hörsal
<i>Lunch</i>		
12.45 - 19.00	Internal Panel Meeting (individual schedule) Dinner at Uppsala Castle by invitation from the Vice-Chancellor	Restaurant Syltan Rikssalen, Uppsala Castle

Schedule for interviews with Units of Assessment (UoA)

Interviews with UoAs will take place during Tuesday May 5, Wednesday May 6, and Thursday May 7 (dates depend on the number of UoAs to be assessed). The time allotted for each UoA varies according to the size of the unit (between 45 minutes and 2 hours). Time for internal panel discussions is scheduled before/after each interview. Individual schedules for each panel are published on the Quality and Impact website.

Schedule for Oral summary reports

All panels finish by giving an oral summary report for University and Faculty representatives and the Evaluation Management Team. The presentation should be short and allow time for questions. Each panel has 30 minutes (including questions). The presentation should focus on the main results and issues that the Panel likes to highlight. The panels only participate in their own presentation. (Place: Loftets lilla sal)

Day	Time	Panel
Wednesday May 6	13.00 - 13.30	7. Biomedicine
	13.35 - 14.05	4. Food Science and Safety
	14.05 - 14.30	<i>Break</i>
	14.30 - 15.00	13. Plant science
	15.05 - 15.35	15. Chemistry, Molecular Biology and Microbiology

Schedule for Oral summary reports, continued:

Thursday May 7	13.00 - 13.30	11. Plant Production
	13.35 - 14.05	14. Genetics and Breeding
	14.10 - 14.40	9. Biosystems Technology
	14.40 - 15.10	<i>Break</i>
	15.10 - 15.40	10. Plant Protection
	15.45 - 16.15	12. Soil and Aquatic Sciences
Friday May 8	08.30 - 09.00	5. Animal Health
	09.05 - 09.35	6. Animal Husbandry
	09.35 - 10.00	<i>Break</i>
	10.00 - 10.30	1. Economics and Statistics
	10.35 - 11.05	3. Ecology and Environmental Sciences
	11.10 - 11.40	8. Forest Management and Products
	11.40 - 13.00	<i>Lunch</i>
	13.00 - 13.30	2. Landscape Architecture, Urban and Rural Development

Chairperson meetings

Pre-evaluation meeting

All chairpersons are invited to a dinner at which they will be briefed about the evaluation by the Director and Deputy Director of the project Quality and Impact. The dinner is held at Hotel Linné Sunday May 3 at 18.00. The Evaluation Management Team and panel hosts will participate.

Post-evaluation meetings

One chairperson meeting will be held each day, Wednesday – Friday. The chairpersons participate the same day as they give their oral summary report (see above). The meeting will be an informal discussion with the Evaluation Management Team about the evaluation process and the outcome of the assessment. (Place: Loftets lilla sal)

B 5

Template for reports from Scientific panels

Report Template – Part A

Research field/Panel (no. and name):	
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The aim of the evaluation Quality and Impact is to make an in-depth and objective assessment of the standing of SLU's research, and environmental monitoring and assessment, in an international perspective. This template refers to the document Instructions for the Scientific Panels, in which the principles for evaluation are described in detail.

The Scientific Panels are asked to evaluate the UoA against the four criteria, i.e. Quality and Impact, Recognition and leadership, Relevance and impact, and Strategy and potential. On the basis of this evaluation, the Panels are asked to make recommendations about how research and, where relevant, environmental monitoring and assessment (FOMA) at the UoA might be strengthened further. The comments should be made in the light of the descriptions in the Self-assessment, relevant indicators (including the bibliometric analyses) and information gathered during the meeting with the UoA. If the UoA is large (> 20 researchers), the Panel may comment on a sub-unit level, if suitable.

Comments and recommendations should be reported using the format given in this template. Report length is at the discretion of the Panel Chair; however, recommendations are indicated for each section of the report. Concise reporting is welcomed.

Reports should be delivered digitally. Please submit each part as a separate Word document, i.e. one Part A, plus one Part B for each UoA.

- > *A preliminary version should be delivered before the panel leaves Uppsala, either on a USB stick that is given the Evaluation Management Team, or sent by e-mail to Elisabeth.Rubbetoft@adm.slu.se.*
- > *The final version should be submitted no later than 15 May to Elisabeth.Rubbetoft@adm.slu.se*

A. General Assessment of the Research Field at SLU

Give brief reflections on the content and strength of the Research Field at SLU, as well as its future potential. If appropriate, comment on issues such as synergies, multi- and interdisciplinary activities including FOMA and strategic coordination between the UoA as appropriate. Comment on infrastructure that facilitates world class research. The Panels may also point out if important research areas are missing. *(Recommended length: Maximum 1 page)*

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Report Template – Part B

NB: Please see instructions in Report Template – Part A!

Research field/Panel (no. and name):	
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B. Report on individual Unit of Assessment

UoA (no. and name)	
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B 1. General assessment of the Unit of Assessment

Give a brief account of the impression of the research at the UoA. Comment on the current research profile with regard to content, depth and breadth. When appropriate, comment on multi- and interdisciplinary activities, as well as synergy between research and environmental monitoring and assessment (FOMA). *(Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)*

[All frames will adapt their size to the text entered.]

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B 2. Performance of the Unit of Assessment against the Evaluation Criteria - Research

For detailed definitions of the criteria, see 'Instructions to the Scientific panels'.

1. Scientific Quality

Comment on the scientific quality (originality of ideas, choice of methods, scientific productivity, impact and prominence) with emphasis on identifying strong research and successful research constellations. In addition, comment on the geographical scope and quality of academic networks and collaborations.

(Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)

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On the basis of this evaluation, award a score from 1-6 ¹:

¹ *Scientific quality* - The UoA performs at a standard that is: 6= World-leading; 5= High international; 4= Internationally recognised; 3= Moderate; 2= Inadequate; 1= Poor

2. Recognition and Leadership

Comment on the UoA's ability to lead the scientific debate in its field and to provide an attractive research environment. Comment on the UoA's broader role in society as an independent and trusted source of opinion.

(Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)

On the basis of this evaluation, award a score from 1-6²:

3. Relevance and Impact

Comment on the UoA's ability and future potential for generating knowledge that will contribute to sustainable development of society, including industry .

(Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)

Comment on the *geographical* (a: regional/national; b: Nordic/European; c: global) and *temporal* (a: short-term; b: medium-term; c: long-term perspective) dimensions.

On the basis of this evaluation, award a score from 1-6³:

4. Strategy and Potential

Comment on the future research potential of the UoA, identifying areas of high and realisable potential in the UoA's strategic plan. In particular comment on the UoA resources for renewal; note whether younger faculty are being developed/recruited to support the UoA's strategic direction. Comment of the gender balance in the UoA. Comment on whether synergies between different UoAs at SLU are being developed to their full potential.

(Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)

On the basis of this evaluation, award a score from 1-6⁴:

² *Recognition and leadership*: 6= Outstanding ; 5= Excellent ; 4= Good; 3= Moderate; 2= Inadequate; 1= Poor

³ *Relevance and impact* - The research performed by the UoA is, or will be of: 6= Utmost importance; 5= Very high importance; 4= High importance; 3= Moderate importance; 2= Little importance; 1= No importance

⁴ The UoA's *strategy and potential* is: 6= Outstanding ; 5= Excellent ; 4= Very good; 3= Good; 2= Inadequate; 1= Poor

**B 3. Performance of the Unit of Assessment against the Evaluation Criteria –
Environmental monitoring and assessment (FOMA)**

Where appropriate, comment on the UoA's FOMA operations in relation to i) Quality, ii) Recognition and leadership; iii) Relevance and impact, and iv) Strategy and potential. (Recommended length: Maximum ½ page. If the UoA has extensive FOMA operations, 1 page)

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B 4. Actions for development at the Unit of Assessment

Comment on how the UoA might further strengthen its research and/or the relevance of its research. In particular, identify how the UoA might strengthen its international links to promote positive development. Where appropriate, comment on strategic development of FOMA activities. (Recommended length: Maximum ½ page. If the UoA is large, i.e. >20 researchers, 1 page)

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B 5. Additional information

Comment on other issues of choice or issues that cross across research area boundaries that SLU should consider at a strategic level. (Recommended length: Maximum ½ page)

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B 6

Template for reports from Stakeholder panels
(in Swedish)

Rapportmall för intressentpanelerna I-IV

Panelens nr och namn	
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Intressentpanelernas uppgift är att med hjälp av egen erfarenhet, sammanställt underlagsmaterial, intervjuundersökning, samt intryck från workshopen med relevanspersoner från de vetenskapliga panelerna., granska och värdera SLU- forskningens nyttiggörande. Bedömningen görs områdesvis utifrån följande kriterier:

1. Teknisk kvalitet och relevans
2. Funktionell kvalitet
3. SLU:s image
4. Framtida utmaningar

Kriterierna beskrivs i detalj i Instruktionens bilaga nr 2. Panelerna uppmanas att lyfta fram enskilda grupperingar som man anser gör särskilt värdefulla insatser och motivera dessa, dvs. peka på viktiga faktorer som leder till framgång. Viktigt är att också lyfta fram områden där kompetens, forskning och/eller kommunikation saknas eller är otillräcklig sett ur intressentsynpunkt.

Panelens rapport bör skrivas på svenska som ett Worddokument. Rapporten ska följa denna mall och bör omfatta totalt *ca. 10 sidor*. Panelen avgör själv de olika avsnittens omfång (rekommendationer ges nedan). Sekreteraren skriver med stöd från panelen rapporten och gör slutredigering enligt panelens anvisningar. Ordföranden ansvarar för att rapporten färdigställs och inlämnas.

- *En preliminär version ska lämnas till KoN den 25 juni* i samband med panelmötets slut (på USB-sticka eller mail till boel.astrom@adm.slu.se).

- *En slutlig version av rapporten, som godkänts av panelordföranden, ska skickas (som wordfil) senast den 3 juli* till boel.astrom@adm.slu.se.

A. Sammanfattande bedömning för området

Ge en sammanfattande bedömning av området i stort. Ange styrkor och svagheter, möjligheter och hot samt panelens viktigaste rekommendationer och förslag.

(*detta fönster anpassas till textens omfattning*) Rekommenderat omfång: 1,5 sid.

B. Kriterierna 1-4

För de *tre första kriterierna* ska panelerna utgå ifrån den bild/bilder som ges i de olika underlagen, inklusive diskussionen med relevanspersonerna och redovisningen av intervjuundersökningen. Panelen bör kommentera om man anser att bilden/bilderna stämmer och komplettera/justera utifrån sina egna erfarenheter.

Det fjärde kriteriet (B 4), som är framåtsyftande, är det viktigaste och panelerna bör ägna mest tid åt detta.

För varje kriterium bör goda exempel anges, vad som saknas/är otillräckligt samt de avgörande framgångsfaktorer som panelen identifierar.

B 1. Teknisk kvalitet och relevans

Bedöm *vad* som levererats, dvs. om SLU har forskat på rätt saker ur nyttsynpunkt såväl direkt som på längre sikt. I vilken grad har kunskapen varit relevant och lett till resultat för respektive intressent? Hur har SLU bidragit till demokrati- resp. kunskapsutveckling, kommersialisering samt som rekryteringsbas?

Beskriv/ge exempel på *produkter, tjänster, funktioner, beslutsunderlag m.m. som har genererats*. Exempel på områden där det fungerar bra/mindre bra/saknas samt motivering bör ingå.

((detta fönster anpassas automatiskt efter textens omfattning) Rekommenderat omfång: 1,5 sid

B 2. Funktionell kvalitet

Bedöm *hur* kunskapen utvecklats, paketerats och förmedlats. Hur har den differentierats och anpassats till respektive intressent, dvs. nyttan i sitt sammanhang? Hur tas externimpulser tillvara? Hur ser processerna ut, dvs. hur arbetar SLU ur ett kund/ intressentperspektiv? Beskriv utifrån egna erfarenheter.

Miljön där forskning möter övriga samhället, dvs. informationen, kommunikationen/dialogen är viktig. Vilka är arenorna, nätverken, mötesplatserna, kommunikationsverktygen? Exemplifiera vilka som har fungerat bra/mindre bra/saknas och motivera, dvs ange vilka kännetecknen är för framgångsrik nytta.

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B 3. SLU:s image

Vad har panelen för syn på SLU? Vilket anseende har SLU och hur synligt är SLU? På vilket/vilka sätt behövs SLU? Vilka är SLU:s mervärden? Vilka är förhållningssätten och incitamenten till att dra nytta av forskningens resultat?

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B 4. Framtida utmaningar

Syftet med detta kriterium är att belysa vilka *potentialer till ökad nytta* som finns hos SLU och *hur dessa kan utvecklas och utnyttjas*.

Vilka är avgörande strategiska forskningsområden/-frågor att utveckla (teknisk kvalitet och relevans)? Vilka är de avgörande processerna och hur kan de utvecklas (funktionell kvalitet)? Hur kan synen på SLU utvecklas (image)?

Ge inspel, idéer, tankar och förslag inför SLUs fortsatta arbete med att utveckla nyttan genom ömsesidigt värdeskapande. Konkreta rekommendationer välkomnas särskilt!

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C. Övriga synpunkter

Här kan panelen t.ex. kommentera samspelet mellan forskning och utbildning, balansen mellan intern (statsanslag) och extern finansiering, avvägning mellan regionalt, nationellt och internationellt arbete, eller andra aspekter som man vill lyfta fram.

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