Quantitative pest risk assessment and environmental risk assessment in plant health at EFSA

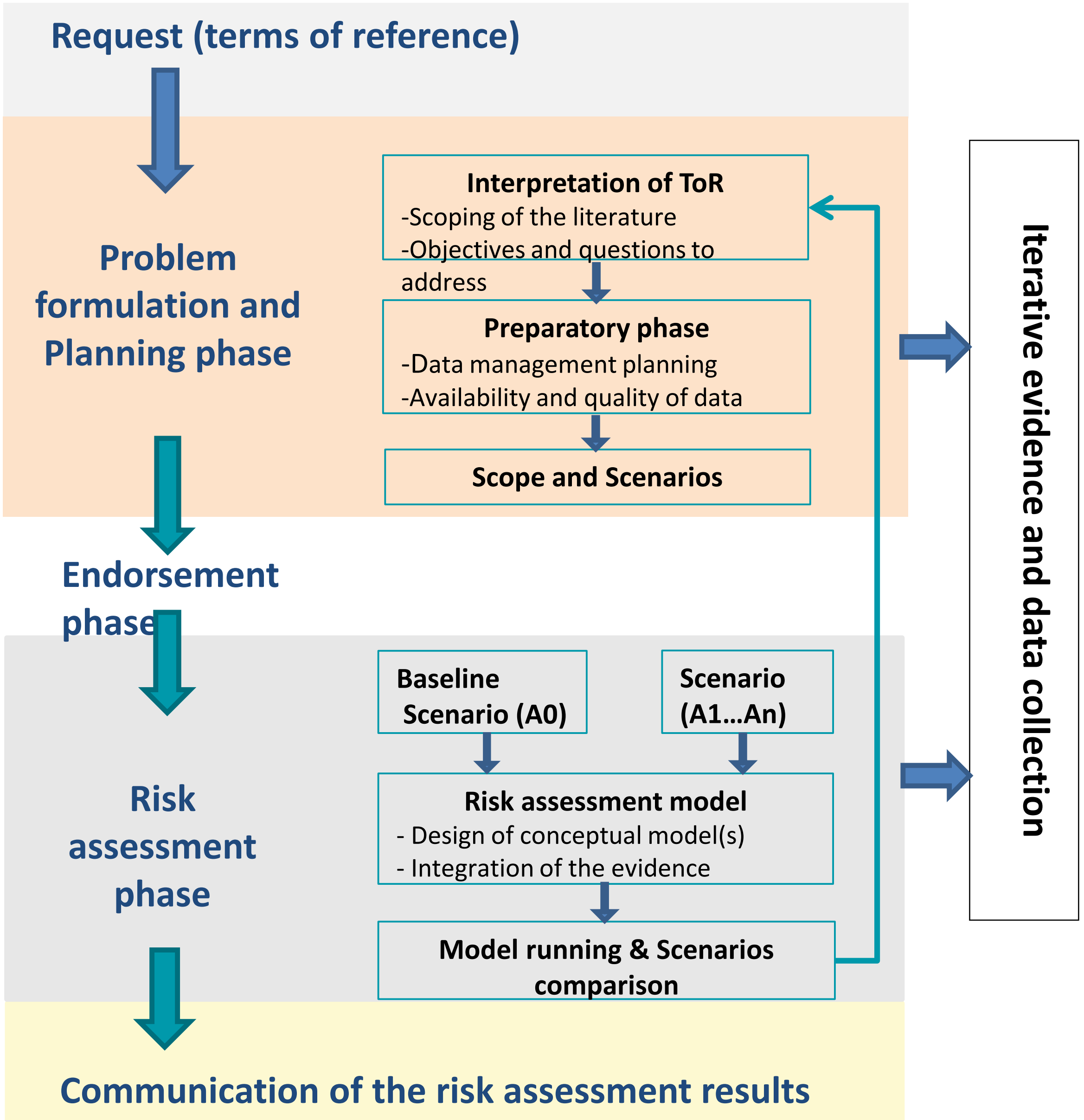
14 November 2017

European Food Safety Authority

OUTLINE

- New methodology for quantitative pest risk assessment
- Example of an environmental risk assessment the apple snail
- Example of the Healthy Bee project

RISK ASSESSMENT PROCESS



European Food Safety Authority

QUANTITATIVE RISK ASSESSMENT

10 years of pest risk assessment by EFSA Plant Health Panel

Need for revision of the RA methodology in Plant Health

Phase 1: 2015/2016
4 pilot studies
-Development and testing

Phase 2: 2016/2017
4 pilot studies
-Fine tune
-tool-kit validation

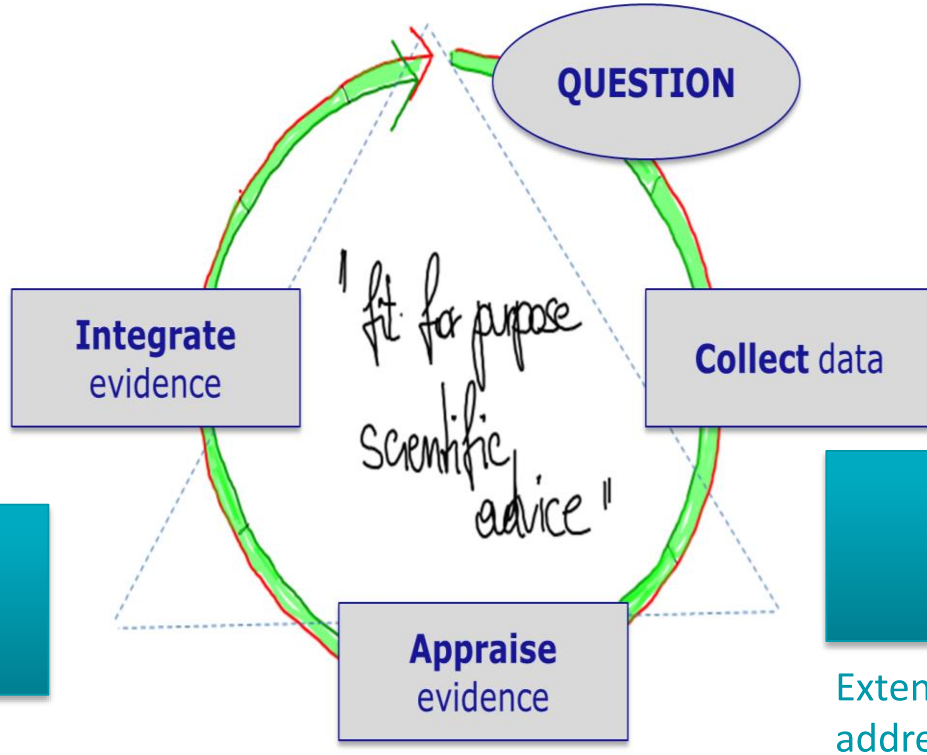
4 Published scientific opinions

4 ongoing scientific opinions
Deadline May 2017

New quantitative approach for Risk assessment

EFSA Draft Guidance on pest risk assessment for public consultation by January 2018

QRA: DEALING WITH DATA AND EVIDENCE



WEIGHT OF EVIDENCE

Function of:
- Relevance
- Reliability

RELEVANCE

Extent to which available data address objectives of the assessment

RELIABILITY

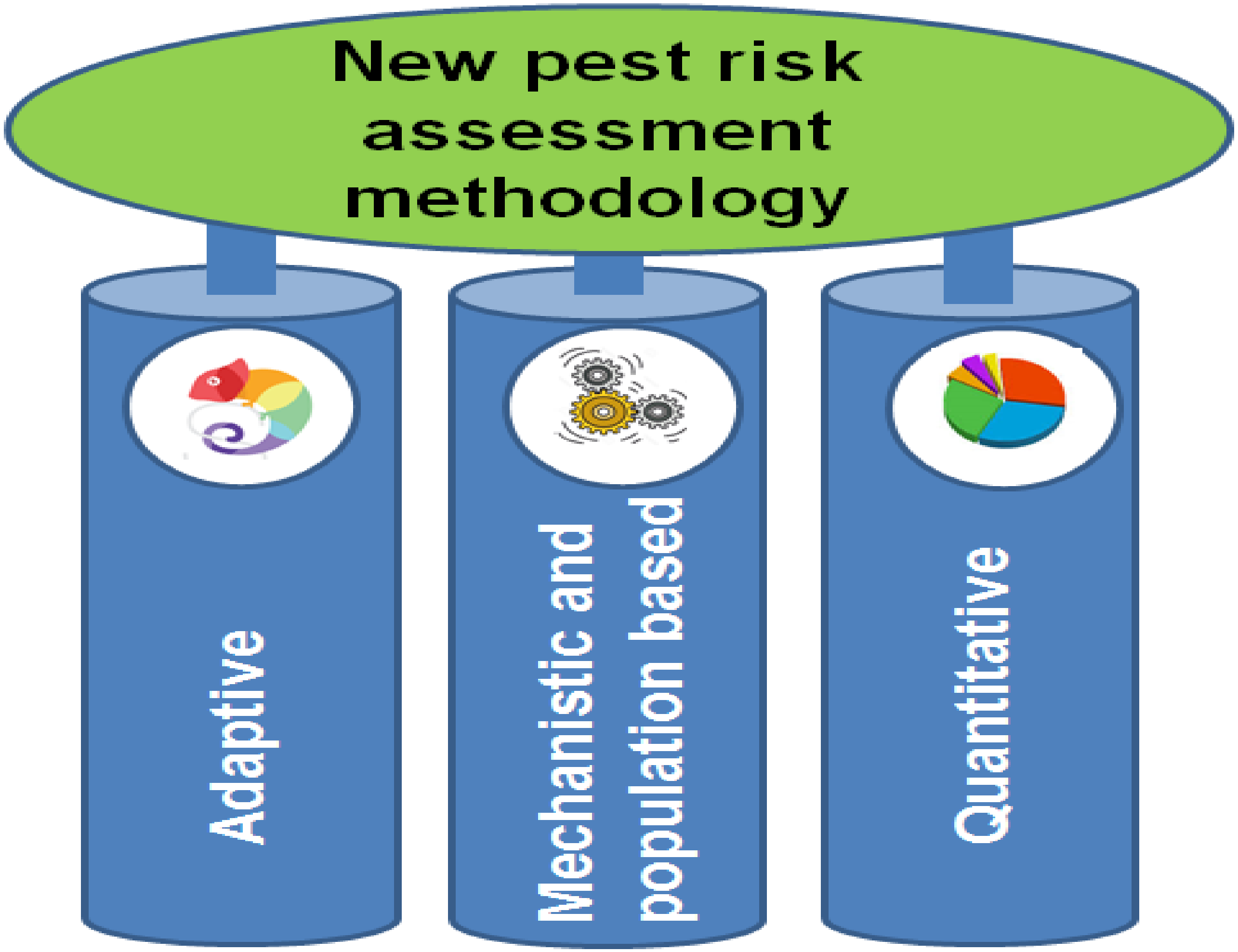
- Accuracy (systematic error)
- Precision (random error)

QRA: USE OF EXPERT JUDGMENT

Key:

- To make all decisions in each step of the "collect/appraise/integrate" process
- When data are limited, as input to the assessment using Expert Knowledge Elicitation (EKE)

QRA FRAMEWORK



QRA ADAPTIVE: RISK ASSESSMENT SCENARIO

Components defining the scenarios for risk assessment

- Pathways
- Spatial extent and resolution
- Ecological factors and conditions (Climate change; change in hosts; resistance and resilience variations)
- Mechanisms of spread
- Time horizon and resolution
- Current regulation
- Identification of the relevant RROs Control and supporting measures

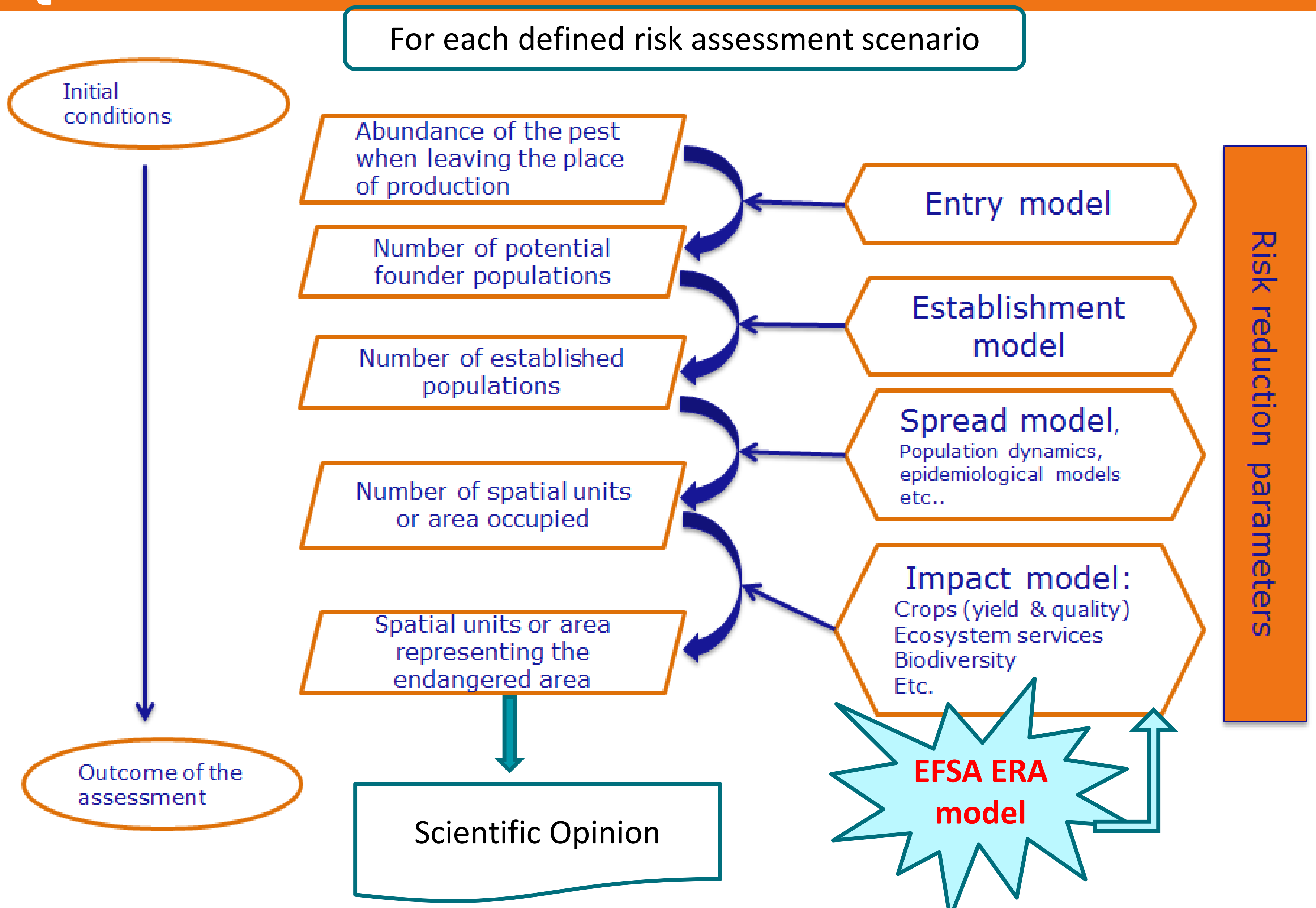
For fit for purpose and explicit risk assessment

scenario 'A0', Baseline scenario is the current situation. A0 is always assessed

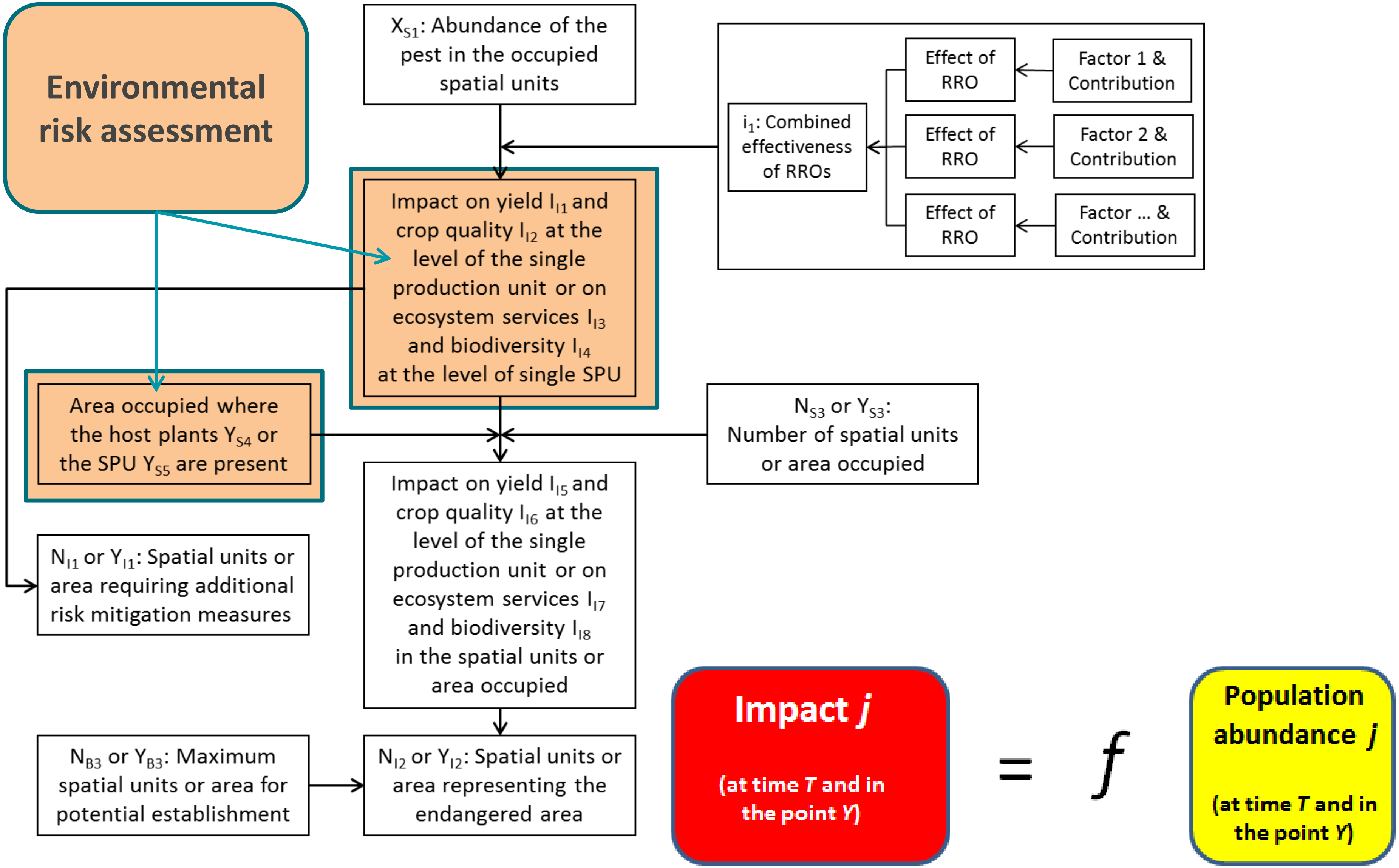
scenarios A1 to An corresponding to changes in the pathways or RROs etc. can be compared with A0

Example Scenario A1: Current regulation in place without the E. lewisi specific requirements (Annex IIAI to Council Directive 2000/29/EC2) and in addition all imported host commodities should come from Pest Free Areas (PFA) in the country at origin (ISPM 4 (FAO, 1995)) and enforced measures on specific pathways.

QRA MECHANISTIC AND POPULATION BASED



ENVIRONMENTAL RISK ASSESSMENT : IMPACT MODEL



QRA: EXAMPLE ENTRY MODEL

Poinsettia demand - Average number of poinsettia plants marketed per year in the EU

↓

Percentage of poinsettias imported from third countries into the EU

↓

Percentage of poinsettia from third countries where *E lewisi* occurs

↓

Conversion of pieces of poinsettia into packs as a pathway unit

↓

Percentage of packs that are infested prior to export

↓

Percentage of infested packs surviving (remaining infested) following export checks

↓

Percentage of infested packs surviving (remaining infested) following transport, shipping & storage - fixed at 100%

↓

Percentage of infested packs that remain infested after EU Import checks - i.e. percentage of infested packs passing border inspection into the EU

↓

Entry result: Average number of infested packs of poinsettia entering EU (per year)

Evidence:

- Mites, in general, are very difficult to detect, especially when they occur at low population densities.
- Based on Dutch import data, and assuming other EU Member States imports follow a similar pattern, most exports occur in January, February and March when, if present, the mite is likely to be at a low population level if coming from a northern temperate country such as USA.

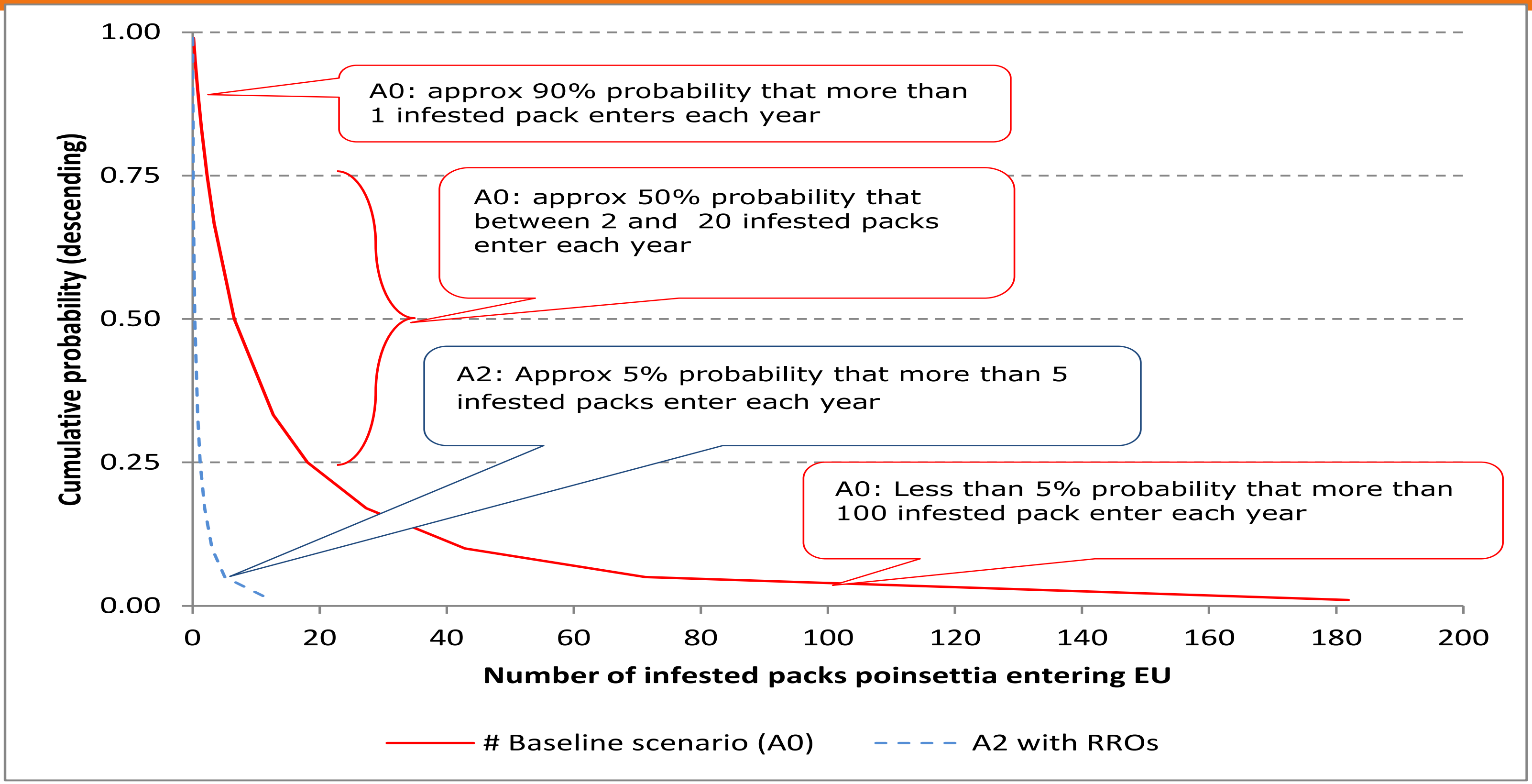
Uncertainties:

- No specific data for this parameter.
- No survey information measuring the performance of export inspections. However, we assume that such inspections are performed at the same level of effectiveness as import inspections. Considering all pests, approximately 72% of infested plants for planting remain undetected following import inspections (Liebhold et al. (2012). Detecting mites is much harder so the 28% success rate is expected to be much lower if only considering mites.
- Over the next ten years improved detection methods for mites are not expected.

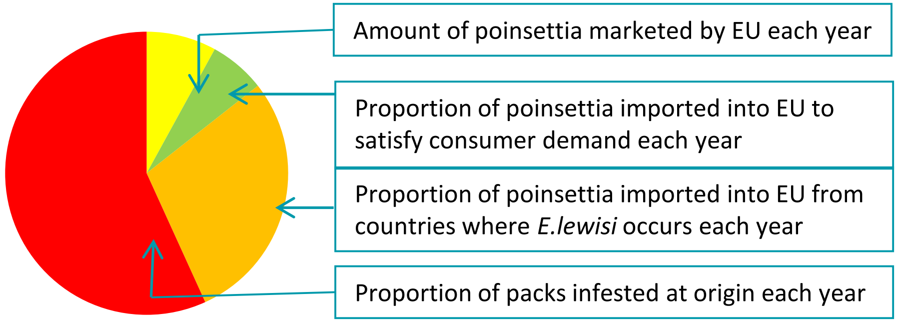
Expert judgement was used to estimate the parameter in five quantiles

Lower (1%)	Q1 (25%)	Median (50%)	Q3 (75%)	Upper (99%)
98.5	99.2	99.4	99.6	100.0

QRA: EXAMPLE RESULTS OF ENTRY MODEL



Contribution of each model parameter to the overall uncertainty for Entry into the EU of the mite through the poinsettia pathway

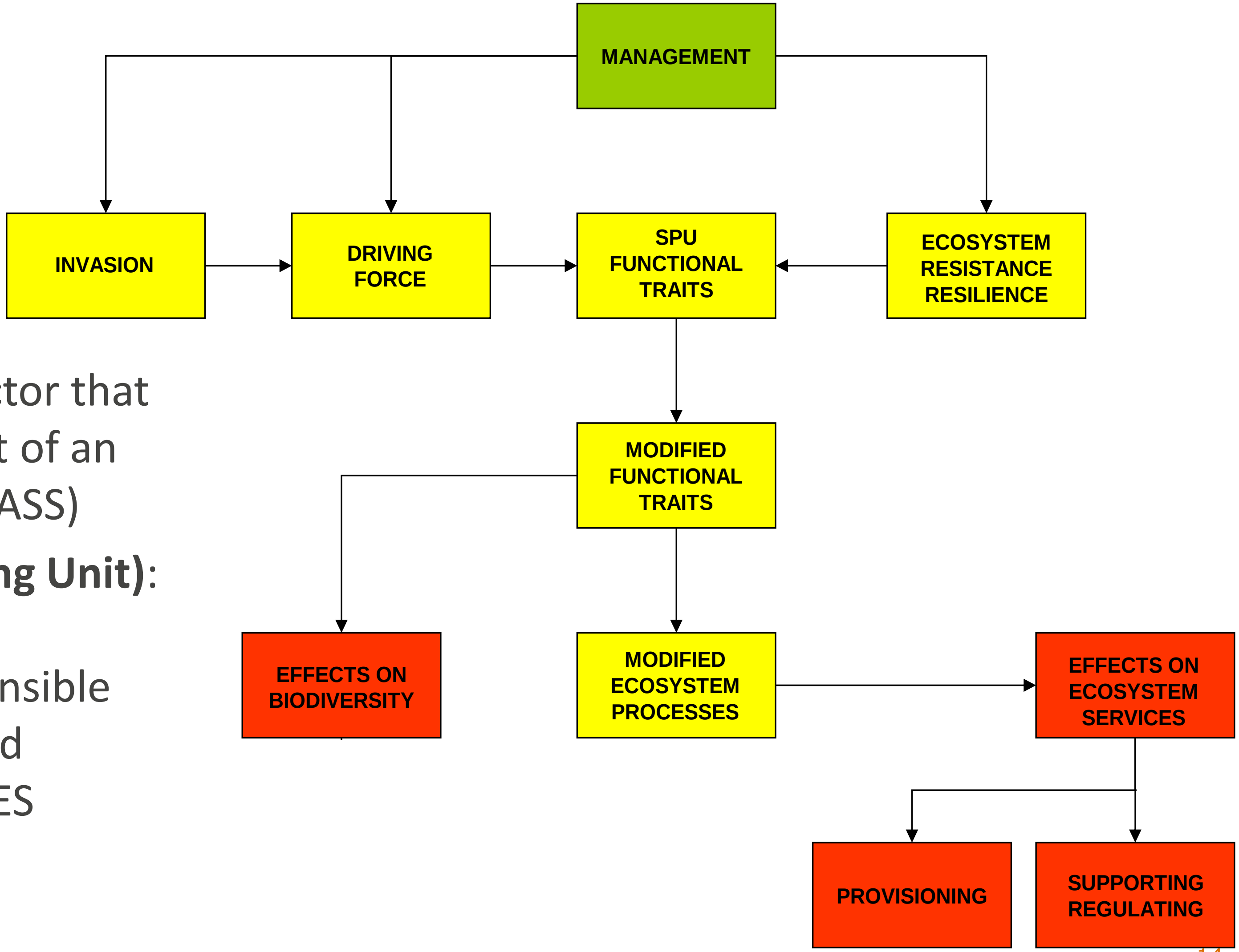


QRA: MECHANISTIC MODELS

- Models are accepted tools for making projections and supporting decision making
- All models are wrong, some are useful
- Entry, establishment, spread and impact can be modelled
- However, information in plant health is invariably uncertain
- Uncertainty can be carried along in making calculations
- Instead of a number, the model outcome is a distribution which represents our knowledge

QRA: EFSA ERA BASED ON ESS

Flux diagram representing stages/pathways for an ERA of invasive species based on biodiversity and ES



Driving force: any factor that changes an aspect of an ecosystem (BIOMASS)

SPU (Service Providing Unit): environmental component responsible for the genesis and regulation of the ES

CONCLUSIONS ON QRA

- **Fit for purpose**
  - Increased transparency of the RA process
  - Possibility to perform a conditional RA (part of RA)
  - Clear identification of the factors increasing the risk
  - More targeted choice of RROs

- **Risk managers and assessors interactions**
  - Proper description of scenarios in ToR (DG Santé; PAFF)
  - Access to data from MSs (e.g survey data, National interception data)
  - Interactions during the risk assessment (DG Santé; AWGs)

8 QRAs published

EFSA Journal on Wiley:

www.efsa.onlinelibrary.wiley.com

Flavescence Dorée Phytoplasma

Ditylenchus destructor

Eotetranychus lewisi

Diaporthe vaccinii

Ceratocystis platani

Cryphonectria parasitica

Radopholus simili

Atropellis sp.

EXAMPLES OF ASSESSING IMPACT ON ECOSYSTEM SERVICES

- Apple snail environment risk assessment

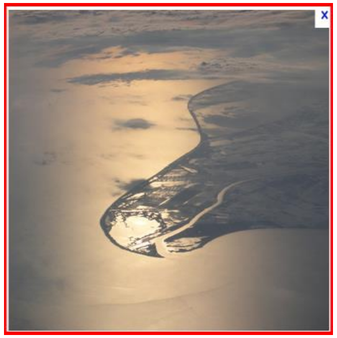
- Healthy-Bee opinion

EXAMPLE OF THE ERA OF THE APPLE SNAIL

- In 2009 an Apple snail invasion is reported in the Ebro Delta in Spain. Today eradication seems unrealistic

- In 2011 the PLH Panel is requested to evaluate a Spanish PRA focussing on rice cultivation

- In 2013 the PLH-Panel self tasked the PLH Panel to perform an environmental risk assessment for the apple snail.

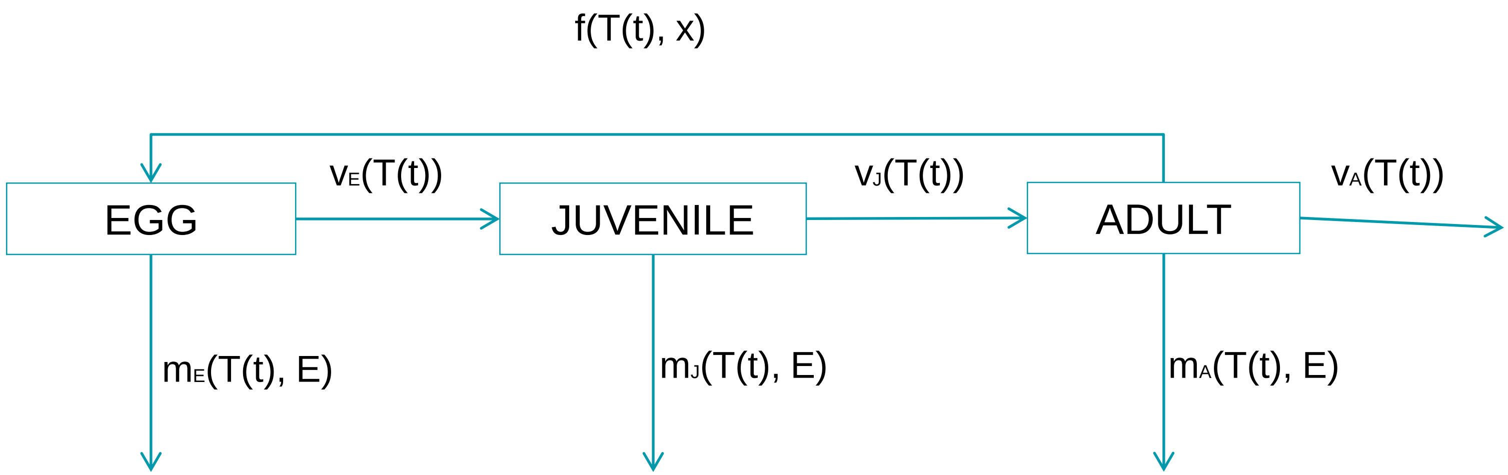


1 snail can eat 17 rice plants per day

Apple snails can transform a macrophyt dominated wetland in phytoplancton dominated one

APPLE SNAIL MODELLING ESTABLISHMENT

THE LIFE-HISTORY STRUCTURE AND FUNCTIONS



$v_i(T(t))$ = development rate as function of T(t)

$m_i(T(t), N_i)$ = mortality rate as function of T(t) and the abundance N_i

$f(T(t), x_A)$ = fecundity rate as function of T(t) and physiological age x_A

efsa European Food Safety Authority

APPLE SNAIL MODELLING ESTABLISHMENT

Development of a temperature dependant model

- Air temperature:

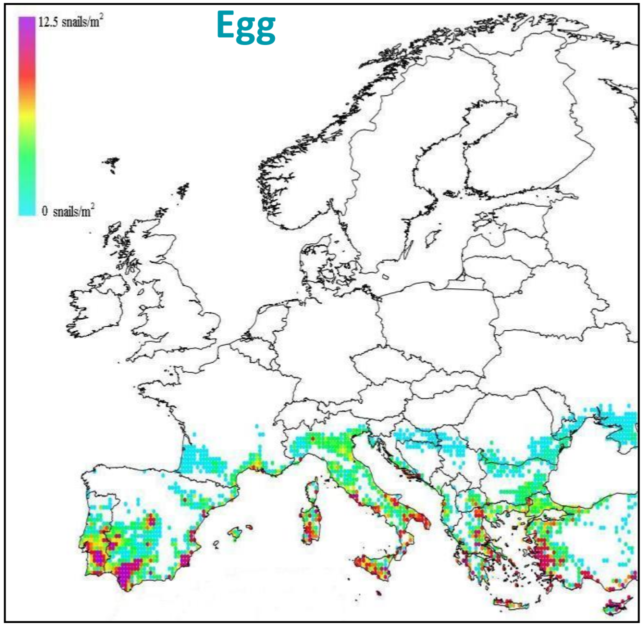
The hourly data of air temperature (AT) are obtained for each grid point applying the de Wit's algorithm

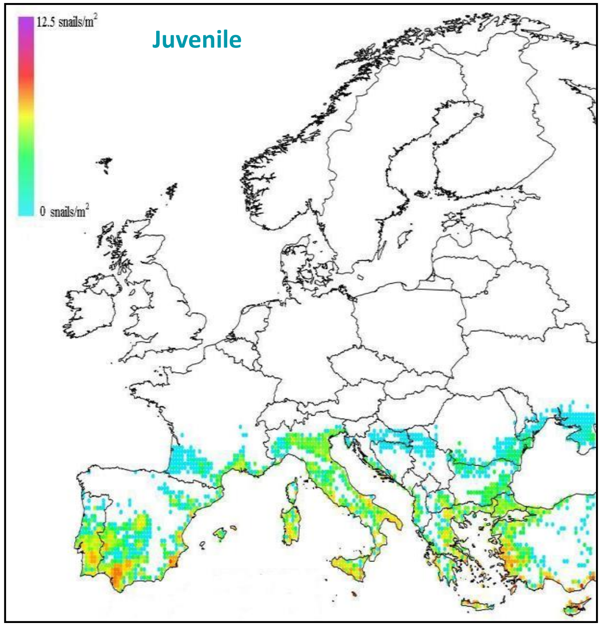
- Water temperature:

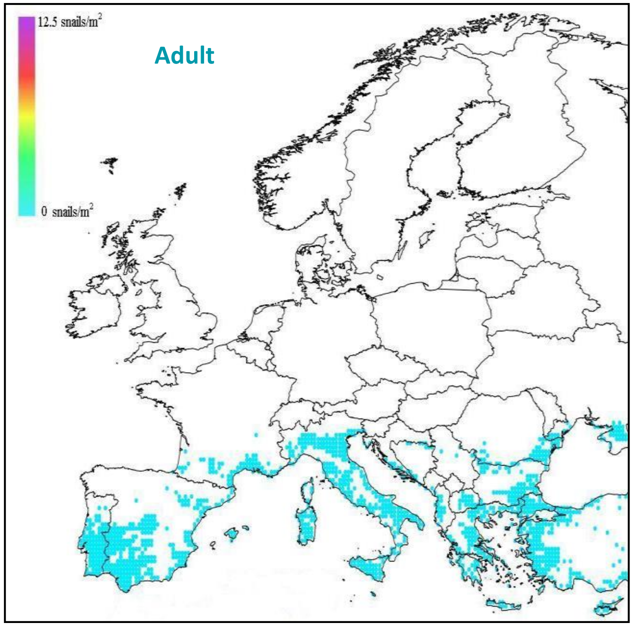
Hourly data of water temperature at -50 cm (WT-50) are obtained applying to hourly AT a semi-empirical model founded on the Fourier equation of heat diffusion

- Bio-demographic functions estimated from literature
- addition of a mortality component (temperature-independent and density-dependent)
- Model was calibrated with data from Argentina
- Model was validated with data from Japan

European potential distribution (mortality 1.5)



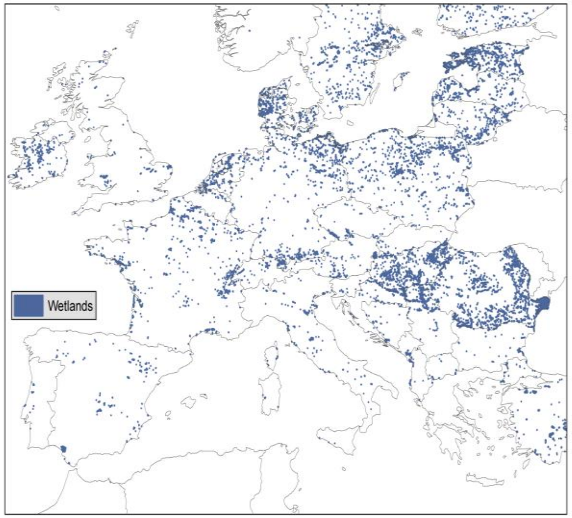




Overlap with rice growing areas in the EU

Overlap with EU wetlands

Risk of establishment can be evaluated from different perspectives



EXAMPLE APPLE SNAIL ERA

Ecosystem services	
Provisioning services	Food
	Fibre
	Genetic resources
	Biochemicals, natural medicines
	Ornamental resources
	Fresh water
Regulating supporting services	Air quality regulation
	Climate regulation
	Water regulation/cycling/purification
	Erosion regulation
	Soil formation and nutrient cycling
	Photosynthesis and primary production
	Pest and disease regulation
	Pollination

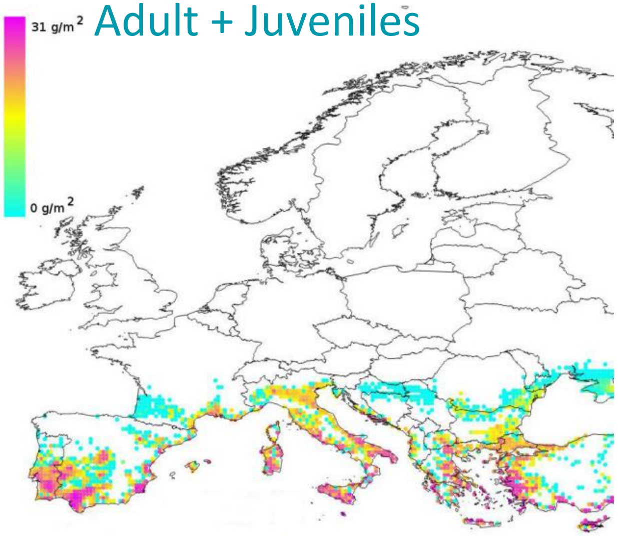
Impact on biodiversity components:

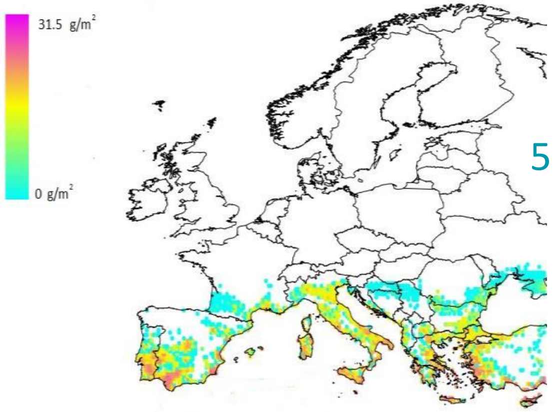
1) On **structural biodiversity** at genetic, species, habitats, communities, and ecosystems levels

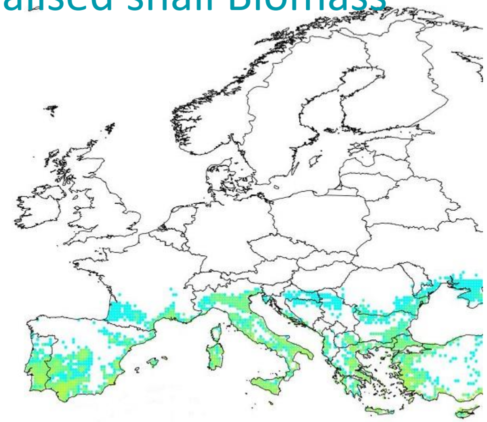
2) On **functional biodiversity** as drivers of ecosystem changes on ecosystem functions (and services)

Biodiversity components
Genetic diversity
Native species diversity
Native habitat, community and/or ecosystem diversity
Threatened species
Habitat of high conservation values

MAPPING ENVIRONMENTAL IMPACT OF APPLE SNAIL



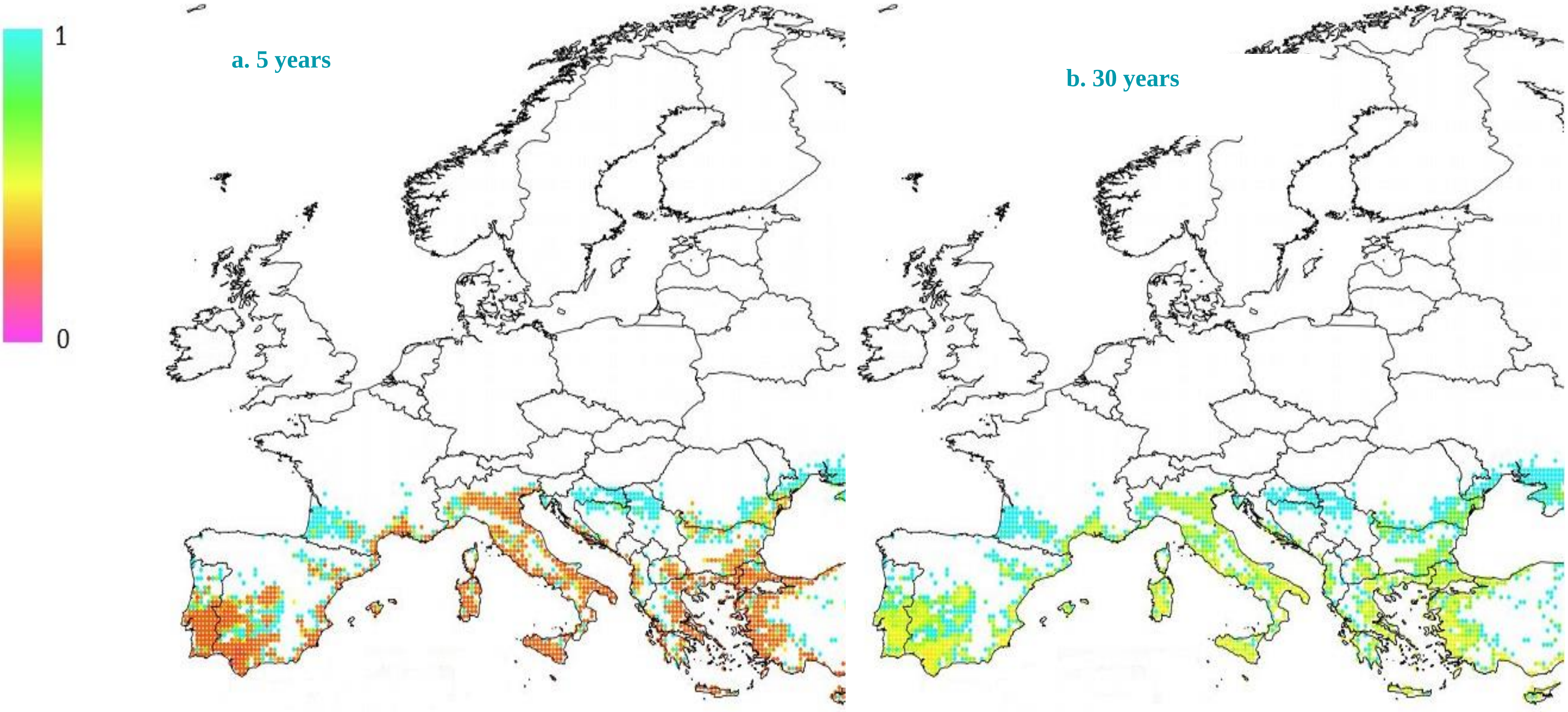




5 years: the population dynamics of the snail have reached the potential maximum level mainly influenced by resistance

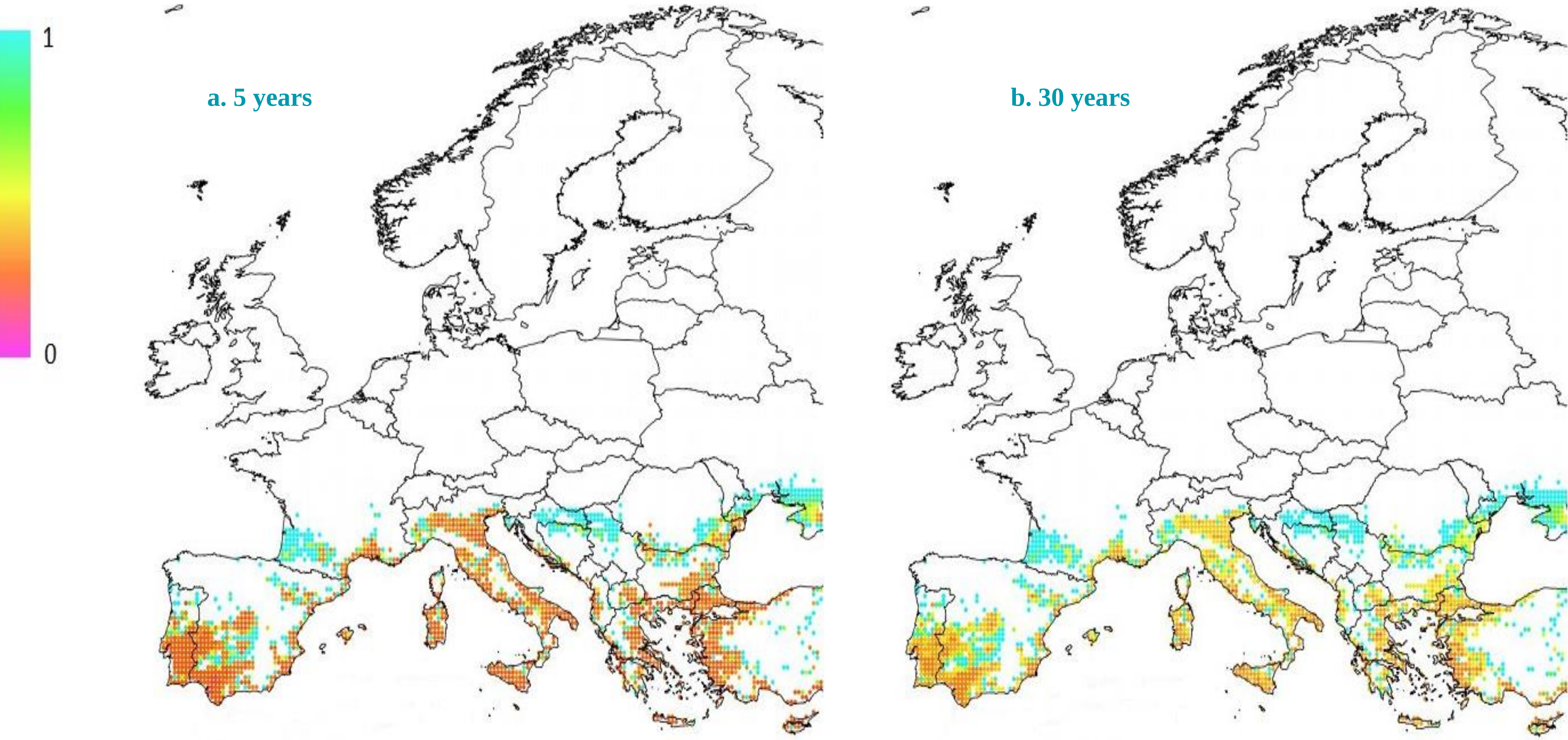
30 years: major role played by resilience

MAPPING IMPACT OF APPLE SNAIL ON HABITAT DIVERSITY

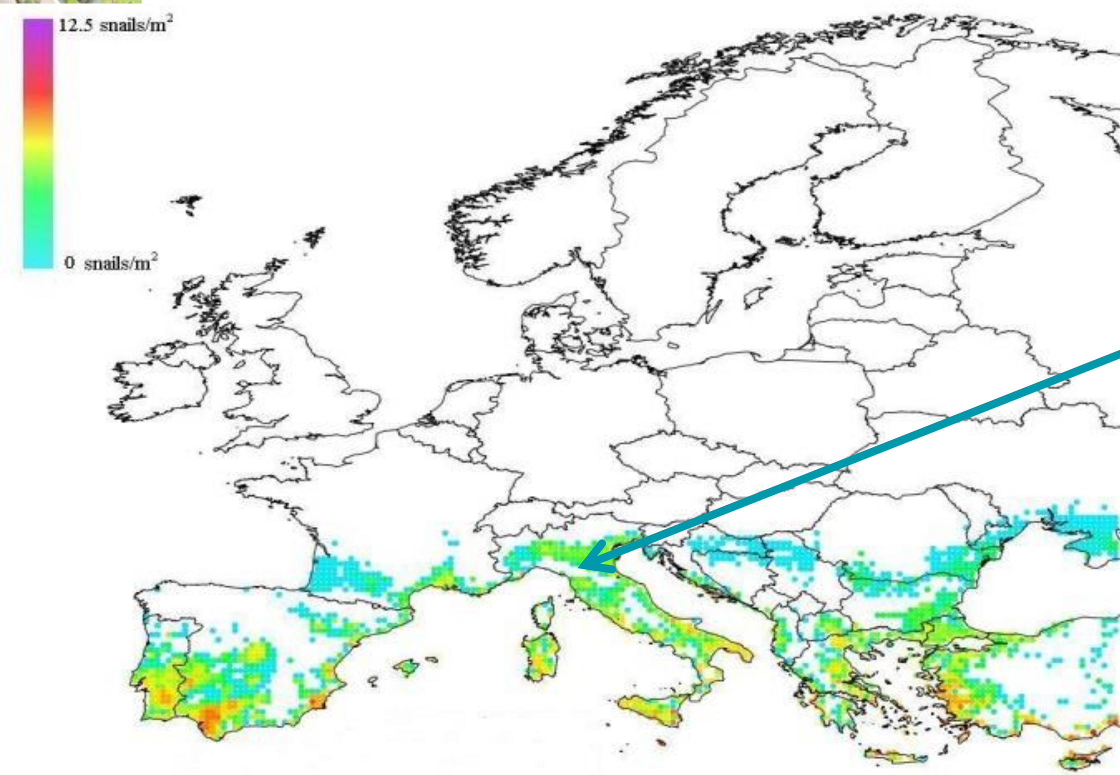


Distribution of the index I_{ET} representing the change in the habitat diversity due to the effects of the realised snail biomass in the two time horizons. Values of the index close to zero correspond to high impact on the ecosystem trait; values of the index close to 1 denote a low impact

MAPPING IMPACT OF APPLE SNAIL ON THREATENED SPECIES



Distribution of the index I_{ET} representing the change in threatened species due to the effects of the realised snail biomass in the two time horizons.



For each node of the grid:

- potential distribution of PB
- presence of the SPU (0, 1)
- Estimate RE, RL, MA
- Derive RB from PB

- ➢ Mapping a risk is a good risk communication tool but…sometimes it is reductive, doesn't provide uncertainties etc.
- ➢ In an ideal world we could map the risk with a common currency accross sectors for evaluating risk from different perspective

efsa
European Food Safety Authority

EXAMPLE 2: HEALTHY-BEE PROJECT

“Assessing the health status of managed honeybee colonies: a toolbox to facilitate harmonised data collection”.

HEALTHY-B toolbox:

- Overview indicators and factors related to bee health
- Measurement and reporting bee health
- Analysis bee health data
- Design field surveys – link to useful guidance documents

Target audience:

risk assessors, risk managers, beekeepers, scientists

efsa
European Food Safety Authority

Background HEALTHY-B

Bee decline in Europe
quantitative analysis and identification risk factors

Epilobee: prevalence infectious agents (2013-2014)
bee mortality

Role of other stressors in bee decline?

Meaning of mortality data?
Difficult to compare data between countries

What is a healthy HB colony?

HEALTHY-B

Which (other) indicators/factors to measure?

How to analyse temporal and spatial changes of an indicator and correlations between indicators/factors?

How to measure indicators/factors?

TOR1: WHAT IS A HEALTHY HONEY BEE COLONY?

A managed honey bee colony is considered healthy when:

- **it has an adequate size, structure and behaviour;**
- **it has an adequate production of bee products;**
- **it provides pollination services**

in relation to the annual life cycle of the colony and region

COLONY ATTRIBUTES , EXTERNAL DRIVERS, COLONY OUTPUTS

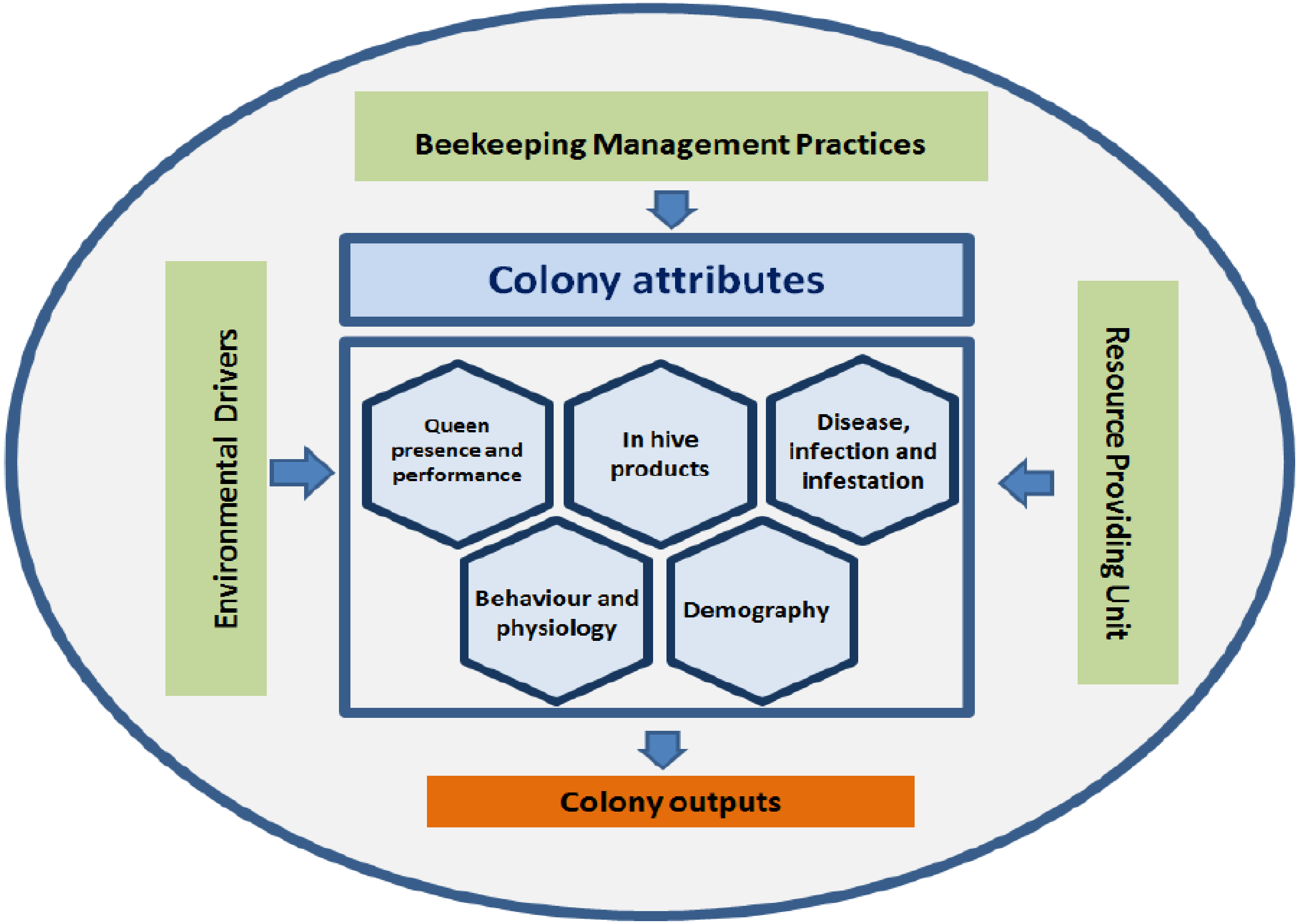
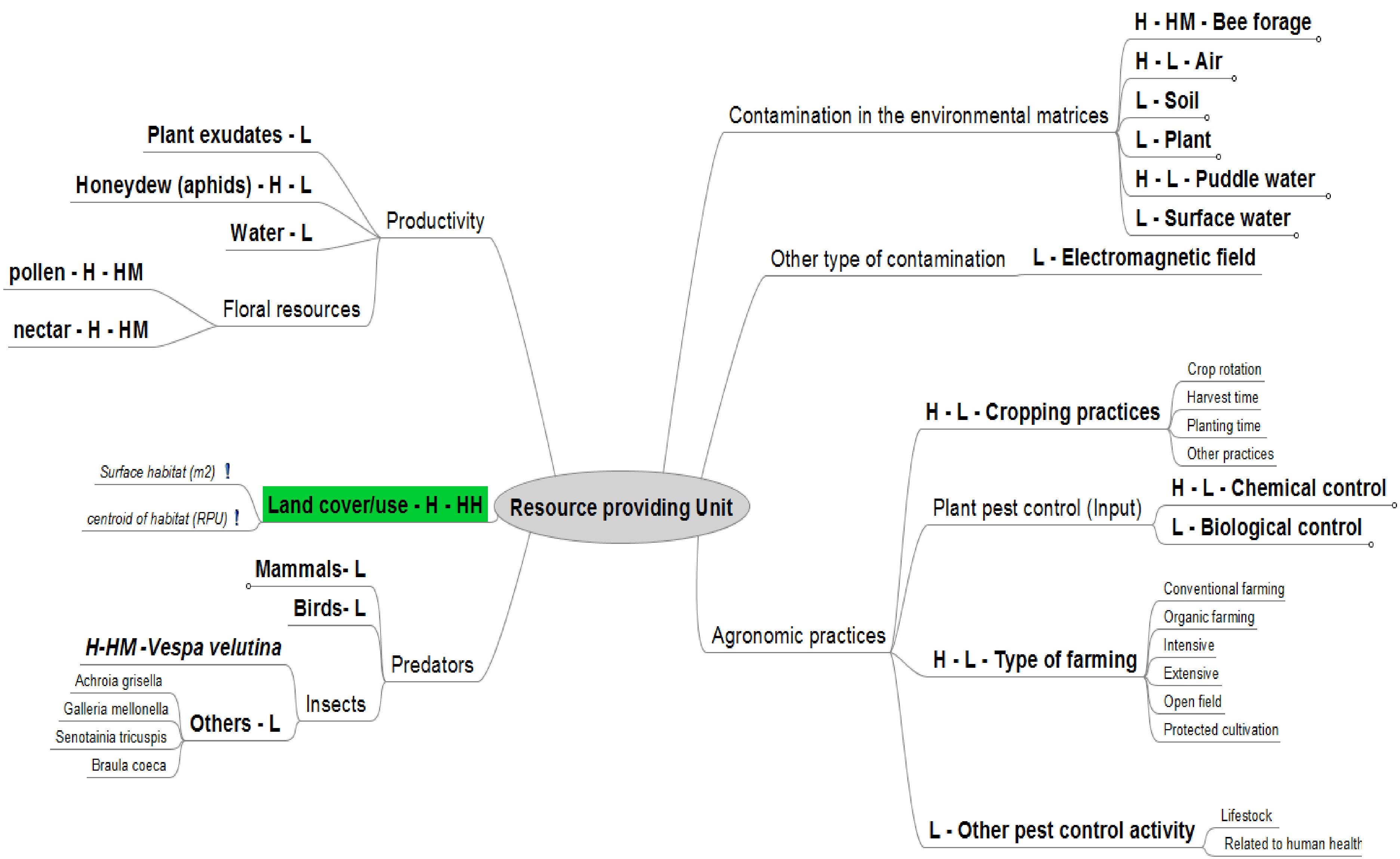
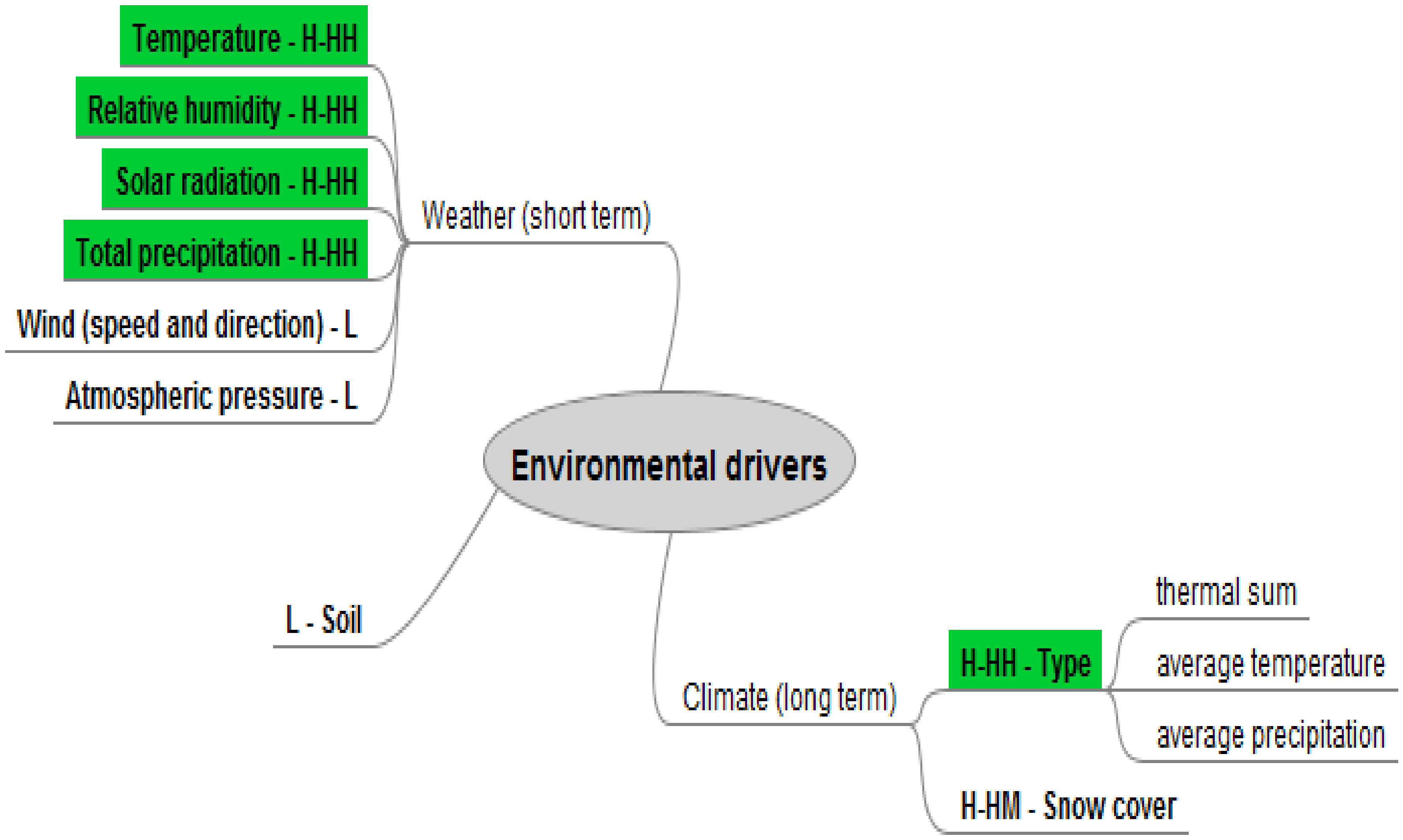


Figure 2. Colony attributes (elements in blue), external drivers (elements in green) and colony outputs (elements in orange) to be considered in a multidimensional assessment of the health of managed honeybee.

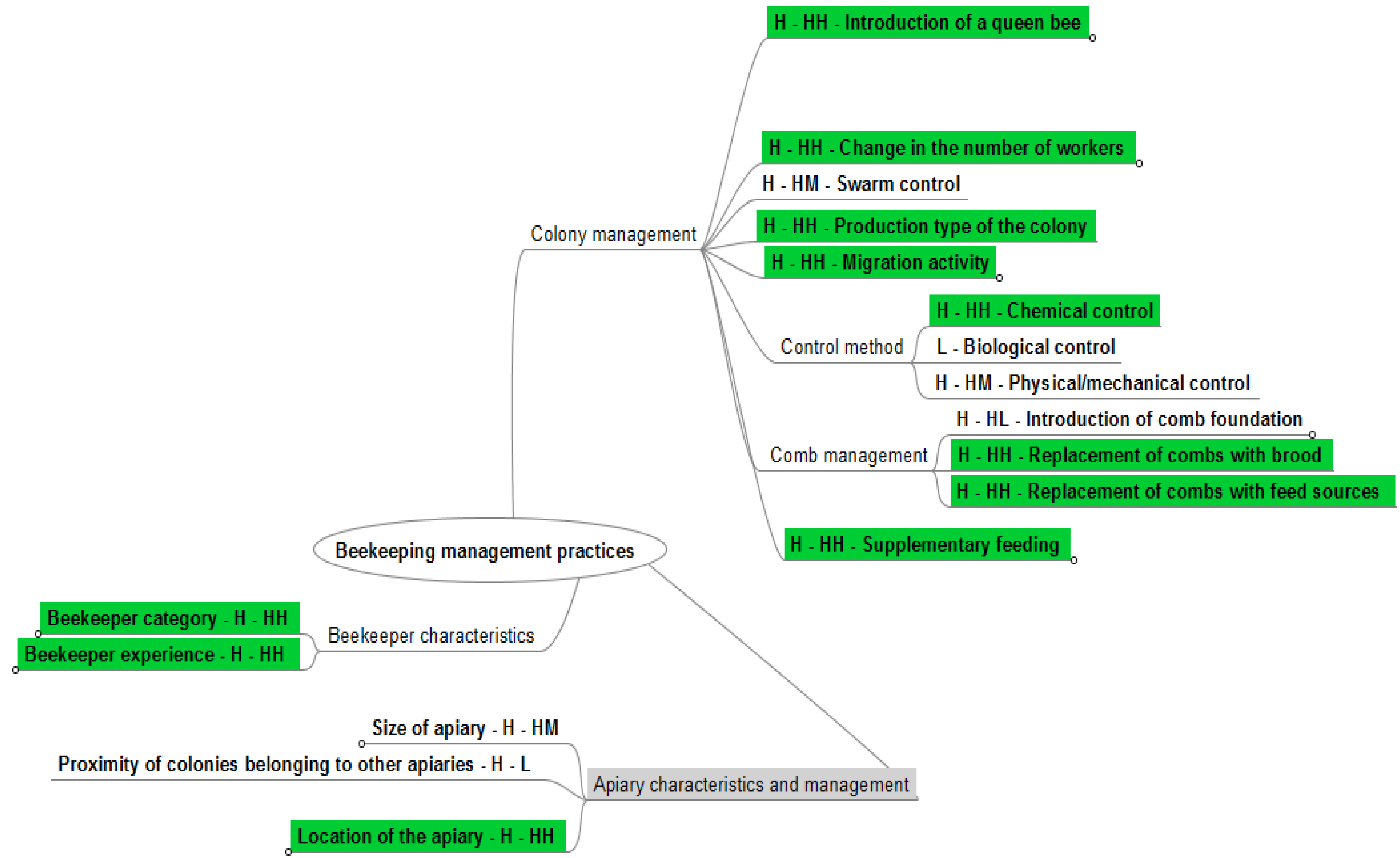
RESOURCE PROVIDING UNIT



ENVIRONMENTAL DRIVERS

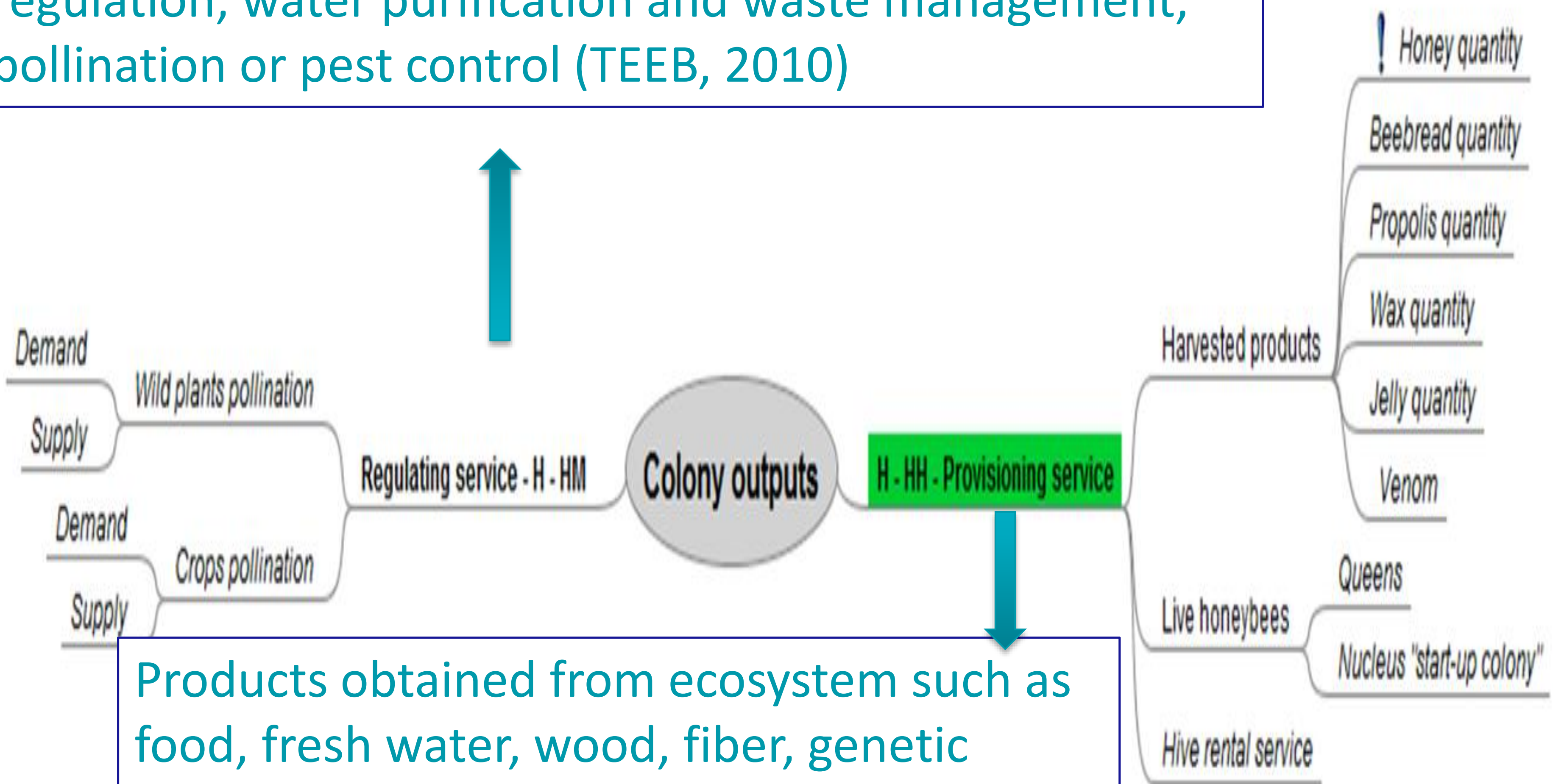


BEEKEEPING MANAGEMENT PRACTICES



COLONY OUTPUTS: ECOSYSTEM SERVICES APPROACH

The benefits obtained from the regulation of ecosystem processes such as climate regulation, natural hazard regulation, water purification and waste management, pollination or pest control (TEEB, 2010)



Products obtained from ecosystem such as food, fresh water, wood, fiber, genetic resources and medicines (TEEB, 2010).

- Aknowledgment to the members of:

EFSA Plant Health Panel

EFSA WG on methods

EFSA ALPHA Unit PLH TEAM

For additional questions:

sybren.vos@efsa.europa.eu