

**2016-01038****Sand, Håkan****Brg1603**

### Information about applicant

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### Information about application

**Call name:** Annual open call 2016**Type of grant:** Project grant**Focus:** Project grant**Call for proposals subject area:** Formas**Project title (english):** The return of the wolf – consequences for sustainable use of natural resources**Project start:** 2017-01-01**Project end:** 2019-12-31**Review panel applied for:** Brg1603, Brg1602, Brg1607**Classification code:** 10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation**Application subject area:** 5203. 23.1 Biologisk mångfald**Keywords:** sustainable use, predation, biodiversity, forest management, harvest

### Funds applied for

**Year:** 2017 2018 2019**Amount:** 969,000 984,000 984,000

### Participants

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## Basic information

### Number of project years\*

3

### Calculated project time\*

2017-01-01 - 2019-12-31

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### Project title (Swedish, max 200 characters)\*

Vargens återkomst – konsekvenser för hållbar användning av naturresurser

### Project title (English, max 200 characters)\*

The return of the wolf – consequences for sustainable use of natural resources

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### Popular scientific description (Swedish) (max 4500 characters)\*

Stora rovdjur har världen över återkoloniserat stora delar av sina forna utbredningsområden under de senaste årtiondena. Ny forskning har visat att stora rovdjur under vissa omständigheter kan ha oproportionerligt stor betydelse för ekosystemens funktion. Genom att rovdjur har stor potential att påverka alla nivåer i näringspyramiden såsom bytesdjurens numerär och beteende och via bytesdjurens fördelning i landskapet även den lägsta nivån i systemet (vegetation). Återkolonisering av stora rovdjur har till och med ansetts som ett verktyg för framgångsrik restaurering av ekosystem. Huvuddelen av studierna har dock genomförts i ett fåtal välkända områden i Nordamerika som har låg grad av mänsklig påverkan, d.v.s. oftast i nationalparker. Av denna anledning har flera av dessa studier kritiserats för att dra alltför långtgående slutsatser och att överdriva betydelsen av stora rovdjurs återkomst ur en global synvinkel.

Återkolonisering av stora rovdjur, inklusive varg, sker också i Europa men en viktig skillnad jämfört med de flesta tidigare studerade områdena i Nordamerika är att de flesta områden i Europa är under kraftig mänsklig påverkan genom t.ex. jakt och skogsbruk. I Sverige har vargen, efter en frånvaro på över 150 år, återkoloniserat delar av dess forna utbredningsområde. De nuvarande förhållandena i Sverige skiljer sig på flera viktiga punkter från många tidigare studerade områden. En av dessa är att människans jakt på vargens viktigaste bytesdjur (älg) har en lång kulturell tradition och har ersatt predation av varg som en viktig begränsande faktor på älgstammen. I Sverige är älg det viktigaste jaktbara viltet med cirka 100 000 skjutna älgar per år och är en årlig höjdpunkt för många av de 260 000 jägarna. En annan viktig skillnad är att det svenska skogsekosystemet är starkt påverkat av det kommersiella skogsbruket. Omfattande betesskador av klövvilt, främst älg, på skogsplanter har under de senaste decennierna lett till en intensiv konflikt mellan markägare och jägare vilket i många områden har lett till en avsiktlig minskning av älgstammens storlek genom ett ökat jaktuttag.

Den senaste tidens snabba ökning av vargstammen i delar av Sverige har resulterat i starka konflikter med allmänheten. En av de viktigaste bakomliggande orsakerna till konflikterna är att vargen genom sin predation på älg konkurrerar med människan genom jakten på framförallt älg. Att denna konkurrens kan vara betydande framgår av den kraftiga minskningen av jaktuttaget av älg som har skett i delar av vargens utbredningsområde. Under antagandet att detta mönster i jaktuttag speglar en verklig förändring i älgstammens storlek kan vi också förvänta oss att detta medför en inverkan på den lägsta nivån i näringskedjan (vegetationen). Detta kan i så fall medföra stora konsekvenser för den biologiska mångfalden av olika betesväxter (rönn, asp, sälg, ek) och även för skadenivåerna på kommersiellt värdefulla skogsplanter (tall). Med tanke på de mål som gäller för bevarande av hotade arter som anges i EU-direktiven, den komplicerade juridiska processen som har åtföljt vargen, och möjligheten till att begränsa vargpopulationen med jakt, är det fullt möjligt att både antalet vargar och populationens utbredning kommer att fortsätta öka.

Huvudsyftet med det föreslagna forskningsprojektet är att förbättra förståelsen av effekterna av en växande vargpopulation och vilka konsekvenser det kan få för regleringen av älgstammen, jakten på älg, omfattningen av skador på kommersiellt värdefulla trädarter, och för funktionen och den biologiska mångfalden i ekosystemet. Vi avser att analysera tidsserier av data på vargens närvaro och hur detta påverkar älgarnas beteende och rumsliga fördelning, älgstammens och jaktuttagets storlek, samt omfattningen av betesskador från älg på skogsplanter på tre olika geografiska nivåer. Detta innefattar analyser på den lokala nivån (skogsbestand), på regional nivå (älgförvaltningsområden, länsnivå), samt att beräkna och kvantifiera den ekologiska betydelsen av varg och sätta detta i relation till betydelsen av ett annat viktigt rovdjur nämligen människan i ett land (Sverige) med en hög grad av mänsklig påverkan. Det föreslagna forskningsprojektet har direkta kopplingar till flera samhällsmål inklusive 1) ökad biologisk mångfald, 2) minskning av skogsskador av vilt, 3) uppnå gynnsam bevarandesstatus för varg, och 4) ett långsiktigt hållbart nyttjande av vilt som resurs.

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### **Abstract (Swedish) (max 1500 characters)\***

Under de senaste 20 åren har vargen återvänt till det svenska skogsekosystemet. Människa, älg och varg påverkar alla ekosystemet via skogsbruk, predation och bete vilket påverkar den biologiska mångfalden och flödet av biomassa mellan trofiska nivåer. Syftet med detta projekt är att förbättra kunskapen om ett återkolloniserande rovdjur (varg) och vilka konsekvenser det kan få för 1) regleringen av stora växtätare (älg), 2) jaktuttag, 3) skogsbruket och 4) den biologiska mångfalden.

Genom att använda tillgängliga uppgifter om 1) älgpopulationernas storlek (spillnings- och flyginventering, jaktdata), 2) vegetation (betetryck/skadeundersökningar), 3) vargtäthet (predation) och 4) skogsbruk (biomassauttag), kommer vi att visa hur de olika aktörerna samverkar och påverkar varandra. Med den kunskapen kommer vi att kunna föreslå strategier för att a) minimera skogsskador, b) anpassa jaktuttagets storlek till ett system med två stora rovdjur (människa och varg) och c) vad som krävs för att uppnå ekologisk funktionalitet för varg.

Det föreslagna forskningsprojektet är direkt relaterad till ett hållbart nyttjande av naturresurser genom att koppla det viktigaste jaktbytet i Sverige (älg), till skogsproduktionen (en av de viktigaste svenska industrierna) samt till återkoloniseringen och bevarandet av en kontroversiell och hotad art (varg). Genom att involvera olika intressegrupper kommer vi att kunna diskutera den bästa användningen av tillgängliga data och lämplig användning av dessa.

### **Abstract (English) (max 1500 characters)\***

During the last 20 years the wolf has returned to the Swedish forest ecosystem. Humans, moose and wolves all affect the ecosystem by forest management, harvest, predation and browsing, and as a consequence they all may impact on biodiversity and flow of biomass between trophic levels. The objective of the project is to improve the knowledge of a returning top predator (wolf) and the consequences it may have for 1) the regulation of large herbivores (moose), 2) moose harvest, 3) forestry, and 4) biodiversity.

By using available data on 1) moose (pellet counts, aerial surveys, harvest data), 2) vegetation (browsing/damage surveys), 3) wolf density (predation), and 4) forestry (biomass outtake), we will show how the different players of this system interact and affect each other. With that knowledge at hand we will be able to suggest strategies to a) minimize forest damage, b) adapt harvest size to a system with two top-predators (humans and wolves), and c) attain the ecological functionality of wolves.

The proposed research project directly relates to the sustainable use of natural resources in terms of linking the most important game species in Sweden (moose), to forest production (one of the most important Swedish industries), and to the conservation and re-colonization of an iconic and endangered top predator (wolf). By involving stakeholders at an early stage we will be able discuss the best use of available data and how to prioritize to optimize the outcome of the project.

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## Research programme

### Specific aims and objectives of the proposed project and a background description containing an overview of the research area, including key references (max 7 000 characters)\*

#### Context, objectives and relevance

##### The wolf-moose-human-forest dilemma

The Swedish ecosystem is heavily affected by human impact mainly through an intensive forest management and harvest of ungulate populations. Forest management is one of the most important and valuable commercial industries in Sweden<sup>1</sup> and game hunting has a long cultural tradition and constitute both great economic (estimated to 3.1 billion on an annual basis) and recreational value<sup>2,3</sup>.

During the last 10-20 years the number of “key players” has increased in large parts of the Swedish forest ecosystem, now also including wolves in addition to moose and humans. Humans, moose and wolves all directly and indirectly affect the forest ecosystem (e.g. biodiversity and the flow of biomass between different trophic levels) by forest management, harvest, and predation on moose, (Figure 1). Moose affect the system by browsing and can by selective foraging affect both biodiversity and damage levels on commercially valuable forest plants<sup>4,5,6</sup>. Wolves may affect the ecosystem both through the impact on population size and behavior of their prey<sup>7</sup>. As a consequence prey spatial distribution and the intensity of browsing may also be affected<sup>8</sup> resulting in altered damage levels on forest plants. Finally, humans exert a strong impact on all species and trophic levels of the ecosystem primarily through hunter harvest and changes of habitat (e.g. forestry and silviculture).

Recent conservation policy has resulted in a rapid growth and geographical expansion of the wolf population and with a population density that currently is close to biological saturation in some regions of Sweden<sup>9</sup>, i.e. territories bordering each other (Figure 2a-c). In some of these high density wolf areas moose harvest has been reduced with more than 50% (Värmland) only during the last four years (Figure 3) and are likely to be further reduced within the near future. With an expected continued wolf population growth this development may become the norm even over much larger areas and will have large consequences for the cultural tradition of moose harvest and for the use of this natural resource. In addition, wolves through their predation on moose, are also likely to have important indirect effects on the vegetation community in terms of both biological diversity and damage levels to commercially valuable forest plants.

Although both wolves and moose have been thoroughly studied in Scandinavia there is yet a limited understanding on how these “key players” interact and affect each other at the ecosystem level. In particular, the relative importance of wolves and humans for the spatial distribution and population size of moose, and to what extent these interactions may impact on plants and forest biodiversity are currently not known. So far, most studies investigating the effect and functional role of returning top predators have been performed in national parks and in other areas with low human impact, i.e. very different from the Swedish ecosystem.

##### Objectives and gain of knowledge

The main objective of the proposed project is to improve our understanding of the effects of the return of a top predator (wolves) and the consequences it may have for; the regulation of a key browsing ungulate (moose), the human harvest of moose, the harvest of commercially valuable plant species and the biodiversity of the boreal forest ecosystem. The results from this project will increase our understanding on:

1. the effect of wolves on the local (forest stand level) moose distribution pattern and its potential effect on the browsing and damage to commercially valuable forest plants,
2. the effect of wolf predation on the harvest yield of moose on a regional level (counties),
3. to what extent wolf predation may result in large-scale (counties) changes in moose density that in turn may result in altered browsing levels on commercially valuable forest plants (coniferous and deciduous trees), and
4. the relative impact of one “new” top predator (wolves) in relation to another common top predator (humans) in a forest ecosystem with a high degree of human impact.

This knowledge can be applied in the conservation and management in terms of:

- i. how forestry practices could adapt to minimize damages made by moose,
- ii. how harvest size of moose needs to be adjusted to allow a sustainable harvest in the future, and
- iii. how various wolf population sizes and density can result in effects on more than one trophic level, promoting biodiversity and attaining different levels of ecological functionality.

### Importance of the project

Because 1) forest damages made by moose to commercially valuable forest plants is responsible for high economic losses on an annual basis<sup>3</sup> within one of the most important and valuable commercial industries in Sweden<sup>1</sup>, and 2) moose is a valuable game species, there is a strong incentive to strive for a better understanding of the relative role of the interacting “key players” within the Swedish forest ecosystem. The proposed research project relates to several objectives of the society including 1) increased forest biodiversity<sup>10</sup>, 2) reduction of forest damages by ungulates<sup>11</sup>, 3) attaining a viable population of wolves<sup>12</sup>, and 4) a sustainable use of moose populations<sup>13</sup>.

The probability of success of this project is very high, because most data is already at hand. The applicants have all a history of working with large carnivores and ungulates and related research questions. Håkan Sand has a long experience working with population ecology of both moose and wolves, Camilla Wikenros has an expertise in trophic cascades and top down effects from large carnivores, and Johan Månsson has focused his research on browsing damage from large ungulates at different spatial scales. An existing network of stakeholders are already identified and their organizations will be linked to the project as a reference group.

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<sup>10</sup>Naturvårdsverket 2013. Miljömål <http://www.miljomal.se/sv/Miljomalen/>

<sup>11</sup>SOU 2009:54. Uthållig älgförvaltning i samverkan.

<sup>12</sup>Riksdagsbeslut 2013/14:43. Riksdagens protokoll 2013/14:43.

<sup>13</sup>Naturvårdsverket 2015. Strategi för svensk viltförvaltning, Naturvårdsverket.

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### **• Description of the project including a summary of the structure, theory, methods, performance and a plan for scientific deliverables (max 15 000 characters)\***

#### **Solving the dilemma - from forest stands to regional and national scales**

##### Structure of the research project

Our research will be structured at three different geographical scales; local, regional and national. On the local scale (forest stand) we will test the hypothesis that wolf presence results in a behavioral response by moose that has consequences for their spatial distribution and in turn also on the spatial pattern of browsing and damages to commercially valuable forest plants. We will use a long-term dataset on distribution of moose (pellet group counts) and browsing intensity from the Grimsö Wildlife Research Area (GWRA) combined with data from VHF/GPS-collared wolves and moose.

On the regional scale (county) we will quantify how the presence of wolves has affected moose density, harvest, and the pattern of forest damages made by moose to commercially valuable forest plants (especially Scots pine). Data from the County Administrative Boards from moose management units will be used to test the hypothesis that wolf density and distribution is spatially and temporally linked to density of the moose population and therefore also to the size of moose harvest. We will then test if the variation in moose density can be linked to the level and pattern of forest damages.

On the national scale (current and future wolf distribution area) we will model the potential impact of the recolonizing wolf population on forest biodiversity via changes in ungulate population size. We will apply different scenarios of future wolf population development and size for a region predicted to constitute the main distribution area for wolves in Sweden. Based on these scenarios, we will compare the estimated mortality rates on the ungulate prey species resulting from wolf predation with a sustainable human harvest. These results will be used to quantitatively compare the importance of wolf-induced changes of ungulate populations and their potential effect on commercially valuable forest plants to that resulting from modern forest management.

#### *Theory - trophic cascades*

Along with the recent re-colonization by large terrestrial carnivores<sup>1,2</sup> a number of studies have casted new light on the importance of top predators for biodiversity and function of terrestrial ecosystems<sup>3,2</sup>. In particular, their potential and realized effect on other trophic levels of the ecosystem, i.e. trophic cascades<sup>4</sup>, has received much attention (reviewed in<sup>2,3</sup>). These trophic cascades may be either of a direct nature, i.e. affecting the vegetation through a reduction of herbivore numbers through predation, or indirect, i.e. by effects on vegetation through behavioral adaptations of prey as a response to the mere presence of predators<sup>5,6</sup>. As a result of the many studies presenting evidence for the effects of top predators on other trophic levels, reintroductions and re-colonization of large carnivores are being justified as a tool for successful ecosystem restoration<sup>7,8</sup>.

So far, the vast majority of these studies has been localized to a few well known areas, mainly national parks from which it has been claimed that large carnivores in general, and wolves in particular, may have a disproportionately large effect on several trophic levels, and thereby have the potential to significantly affect ecosystem structure and function<sup>2,9,10,11</sup>. However, these studies have been criticized for making too far conclusions and for overemphasizing the importance of large predators comeback to the ecosystem<sup>12,13,14</sup>. In fact, it has been recognized that the effect of top predators is context dependent<sup>7,8</sup>. For example, predation is not likely to be an important structuring force in the ecosystem when prey abundance is not limited by predation, or when the effect of predation does not extend beyond the level of prey<sup>7</sup>. Also, the productivity and density of prey populations relative to the carrying capacity of the environment appear to be important for the extent to which predators will be able to limit the abundance of prey<sup>7, 15, 16</sup>. Finally, even if predation does exert important impact on prey populations, these effects do not always propagate to lower trophic levels or have a significant impact on ecosystem processes. As a consequence, extrapolation beyond regions or across time periods may not be justifiable<sup>8</sup>.

Re-colonization of large carnivore species including wolves also occurs in Europe<sup>1</sup> but unlike most previously studied areas in North America, the carnivores in Europe return to landscapes under heavy anthropogenic influence, with large variation in primary productivity, and with the size of national parks small relative to the areas used by large carnivores (particularly wolves)<sup>17,18</sup>. Because of these differences in land use there is an increasing need to advance our knowledge of the potential effects of re-colonizing large carnivores in areas with high intensity of anthropogenic land-use<sup>19,20</sup>.

#### *Sweden after wolf colonization*

In Sweden moose is the most important game species with approximately 100 000 moose harvested annually<sup>21</sup>. The moose hunt is an annual highlight to many of the 260 000 hunters<sup>22</sup> with the majority of the public being favorable towards a sustainable use of moose and deer meat<sup>23</sup>. However, the large scale effects of moose browsing resulting in damages to forest plants has during the last decades resulted in an intense conflict between forestry and hunters<sup>24</sup> and has led to a management aiming at reducing moose population size in many areas<sup>25,26</sup>.

Another controversy involves the recovery of the wolf into the fauna of Sweden<sup>27</sup>. One of the key conflicts involves competition with humans for game species, mainly moose<sup>28,29</sup>. The conditions in Sweden are very different from many protected areas mainly because hunting has a long history and has during the last centuries replaced predation by top predators as the main regulating factor of the moose population.

The recent increase in the wolf population seems to further have resulted in a reduced number of harvested moose (Figure 3 and 4). If this pattern is indicative of a true change in moose population size we may also predict an impact on the next trophic level with consequences for the biological diversity (increase) and damage levels to commercially valuable forest plants (decrease). Given the conservation goals, e.g. stated in the EU-directives, a future wolf population will most likely expand to a larger geographical area. This further highlights the need of research on the effects of wolf recovery on several trophic levels of the ecosystem.

### Performance and methods

#### *A. Local scale - moose distribution, behavior and forest damages*

We will test the hypothesis that the mere presence of wolves results in behavioral adjustments of moose as an adaptive strategy to reduce the risk of predation. These behavioral adjustments include individual traits such as fine-scale habitat selection, home range use, and philopatry (remaining in the same area after the arrival of wolves) and may have consequences for pattern of moose browsing and damages at the level of the forest stand.

In 2004 wolves established a territory covering roughly half of the GWRA (Figure 5) which offers a unique opportunity to compare moose browsing pattern and moose distribution both before and after wolf re-colonization as well as inside/outside the wolf territory. Response variables; 1) intensity of moose browsing on the main forage species (birch, pine, aspen and *Salix* spp.) and 2) moose density and distribution (pellet groups) have been annually collected (long-term, 1996-2016) at 600 permanent sample plots systematically distributed over the 13 000 ha study area (Figure 5). The collected data also includes background information of forest age, type and composition over the same area (GIS-data). In addition, we have access to data on moose movements with high spatial and temporal resolution from 35 GPS-collared moose and 4 adult wolves from two territories partially covering the GWRA during 2005-2012 and 65 VHF-collared moose during 1982-2005.

Resource Selection Functions will be used to test whether wolf predation risk (wolf utility distribution) and duration (number of years since establishment) influences fine-scaled habitat use. General linear mixed models (GLMM) will be used to relate home range size, and philopatry of moose to wolf presence. By relating the spatial variation of browsing intensity to habitat parameters, moose density (pellet group counts), snow depth and wolf predation risk the relative importance of wolves on patterns of moose browsing can be evaluated.

#### *B. Regional scale - moose population size and damage levels of forest plants*

We will use hunter harvest statistics before and after wolf establishment (20 years) from moose management units within 5 counties (S,W,X,T,U) to investigate the hypothesis that 1) wolf presence and duration will result in a reduction in the size of the moose population and/or reduced human harvest, and 2) the predator-induced reduction in moose density/harvest can be linked to similar changes in browsing intensity and damage levels to commercially valuable forest plants.

For hypothesis 1 we will use harvest size, population size, age and sex composition, and hunter effort as received from moose observation data (<http://www.algdata.se/Sv/statistik/Pages/default.aspx>), pellet group counts, and from regular surveys of forest damages (Swedish National Forest Inventory (SLU) and ÄBIN (Skogsstyrelsen)). We will also use data from aerial counts of moose (>4000 moose observations) to test the hypothesis that wolf presence is linked to a lower density of moose and/or harvest. Aerial counts (2006-2015) have been conducted in 5 counties to achieve data on moose population size and composition. For hypothesis 2 we will use data from both the Swedish National Forest Inventory data and ÄBIN which include vegetation indices with detailed data of forestry actions and browsing damage in combination with indices of moose density.

We will use GLMM to assess the strength and direction of the temporal and spatial relationships between the following variables: (1) wolf density and duration from census data (snow-tracking and DNA-analyses); (2) moose density and harvest data; (3) human impact, measured by forestry actions (clearing, thinning, final felling, afforestation); (4) forage availability, measured as cover of tree and field layer species; and (5) the level of moose browsing damages made to commercially valuable forest plants.

### *C. National scale - estimating the potential for future wolf population growth and trophic cascades*

We will estimate the potential for variable future sizes of the wolf population to have significant impact on several trophic levels of the ecosystem in Sweden. Earlier derived ecological data from VHF/GPS-collared Scandinavian wolves (n=164) will provide empirical estimates the biological level of saturation of the wolf population<sup>17</sup> over a region of south-central Sweden (main area for current and future wolf distribution<sup>32</sup>). Next, we will model how the alternative scenarios of wolf population sizes at this geographical scale may affect the size, density and the potential harvest of ungulate populations (including moose, roe deer, fallow deer and red deer). From this we will model the consumption of biomass of valuable tree species from ungulate populations and will in turn be compared to both the kg biomass and the number of young trees consumed by forest management (pre-commercial thinning, thinning and final felling and limited to the sapling growth stage, i.e. the growth stage consumed by ungulates). As a basis for these calculations we will use simple descriptive estimates from published data on forest production<sup>31</sup> and from forage biomass consumption of ungulates. The strength of this modelling approach lies in the quantitative assessment of impact on the forest ecosystem of both<sup>32</sup> top predators (wolf and humans) and thus on the ecological functionality of wolves in an ecosystem with strong anthropogenic impact.

#### Plan for scientific deliverables

Results will be deliverable in high quality peer-reviewed journals including Open Access: 2 publications from subproject A, 2 publications from subproject B, and 1 from subproject C. Because the data for A and C are already available 2-3 manuscripts can be submitted already within the first two years. For subproject B which requires data compilation we plan for scientific delivery during year 3. The results will also be published as popular science articles in applied journals that are read by forest owners and NGOs (Skogseko, Svensk Jakt, WWF EKO etc.) and made available at Skandulv's (the Scandinavian Wolf Research Project) website (<http://www.slu.se/skandulv>).

#### National and international collaborations

1. Prof. Harry Andreassen, Hedmark University College, Norway. With expertise in environmental science and theoretical production ecology.
2. PhD Märtha Wallgren, Forestry Research Institute of Sweden. With expertise in forest ecology and forest damages made by wildlife.
3. PhD Barbara Zimmermann, Hedmark University College, Norway. With expertise in wildlife ecology and on analytical methods involving resource selection by animals.

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- <sup>21</sup>Wiklund E & Malmfors G 2014. Viltkött som resurs. Naturvårdsverket.
- <sup>22</sup>Naturvårdsverket 2015. <http://www.naturvardsverket.se/Var-natur/Jakt/Jaktkort-och-jagarexamen/Fragor-och-svar/>.
- <sup>23</sup>Ljung P 2012. Wildl Soc Bull. 36:669–675.
- <sup>24</sup>SOU 2009:54.
- <sup>25</sup>Liberg O et al. 2010. In: A. Marco, R. Andersen & R. Putman (Eds.), Cambridge: Camb Univ Press.
- <sup>26</sup>Wikenros C et al. 2015. PLoS ONE 10(4): e0119957.
- <sup>27</sup>SOU 2012:22.
- <sup>28</sup>Ericsson G et al. 2004. Wildl Biol 10:269–276.
- <sup>29</sup>Bisi J et al. 2010. Eur J Wildl Res. 56:771–779.
- <sup>30</sup>Naturvårdsverket 2014. Nationell förvaltningsplan för varg 2014-2019.
- <sup>31</sup>Skogsstatistisk årsbok 2015.
- <sup>32</sup>Baskin LM & Danell K 2003. Ecology of ungulates. Berlin, Springer.

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## **Description of the potential societal value of the research and a plan for communication with stakeholders/end users (max 8 000 characters)\***

### **Societal value of the research question and planned communication with stakeholders**

#### Sustainable use of natural resources

This research project directly relates to the sustainable use of natural resources in terms of linking the most important game species in Sweden (moose), to sustainable use of forest production and to the re-colonization and conservation of an iconic and endangered top predator (wolf). It is also highly relevant to the society because it directly deals with biological diversity, the biological capacity for production of moose and forest, as well as the economic, social and cultural values related to moose hunting.

This research project is also of relevance for forest production and management because the return of wolves to the Swedish ecosystem are likely to impact on both population density of moose and on their spatial utilization of forest stands and thereby also the survival and quality of young and commercially valuable forest plants, e.g. Scots pine.

#### Environmental goals

This project relates directly to 2 (“Levande skogar” and “Ett rikt växt och djurliv”) of the environmental goals decided by the Swedish government<sup>1</sup>. In the broadest sense, the focal species of this research project (humans, moose, wolves, forest plants) and the ecological processes (harvest, predation, herbivory) are all important components of the biological diversity. More specifically, there is a strong link between density of ungulates and biological diversity of forest plants but also in terms of the conservation status of the wolf.

In their new and recently published policy document for the management of Swedish wildlife the Swedish Environmental Protection Agency<sup>2</sup> (SEPA) states that wildlife “...*should be managed in a sustainable way and that this includes ecological, social, cultural and economic aspects.*” A sustainable wildlife management means *balancing between the use and conservation of wildlife species*. This policy also states that wildlife management should be based on an ecosystem view, i.e. with respect to how humans, wildlife species, and the landscape they live in and how they affect each other.

#### Conservation of a vulnerable species

This research project is relevant for the political decisions on conservation and management of wolves on both a national and international level. The wolf is classified as a vulnerable species in Sweden<sup>3</sup>. On numerous occasions during the last 10 years there has been a heated controversy between Sweden and the European Union (EU) on how the Scandinavian wolf population should be managed within the frame of the habitat directive<sup>4</sup>. EU has at multiple occasions questioned wolf management in Sweden and threatened to report Sweden to the EU-court for not following the habitat directive. On the national arena the SEPA decisions on license harvest during several years has been appealed by NGO's to a number of court instances at various levels. These political and juridical affairs have resulted in that the wolf population continues to grow significantly larger than the size considered as having favorable conservation status (FRP) by the SEPA (270 decided in October 2015<sup>5</sup>). Also linked to this is the fact that some scientists and proponents of large carnivore conservation claim that the size of populations should not only represent the demographic and genetic viability, but also that functional ecological role of the species in the ecosystem is fulfilled. The results from the suggested study will help to guide what conditions should be met to achieve such an objective.

#### Two-way communications at three levels

We will apply a three-level strategy for a two-way communication of our results with stakeholders and the society. The relevant stakeholders that are interested in results from this project are the SEPA, County Administrative Boards within the current and future wolf range, hunting organizations, forestry companies and private forest owners, and nature conservation organizations (for example WWF, Swedish Society for Nature Conservation, Swedish Carnivore Association).

#### *National level – three existing channels for communication*

At the national level we will make use of already existing channels established by the Skandulv research group since 1999 for communication of results and feed-back from stakeholders. First, Skandulv annually arranges a three-day work-shop with people invited from the ministry of environment, central managing authorities (SEPA), the regional management on the county level (County Administrative Boards) and NGO's for communicating new research results and to discuss management-related issues. Also national and regional management authorities from Norway and Finland are attending. Second, educational presentations for the Wildlife Management Delegations (including members from all interest groups and politicians) of the County Administrative Boards are already, and will also during this project be given by the three applicants annually. This enables direct communication with the delegates who set comprehensive guidelines for game management and approve county Wildlife Management Plans. Third, our results will be reported at the annual carnivore symposium held in Vålådalen where 200-300 managers from national and regional authorities, journalists, NGO's, other stakeholders and researchers, meet to be updated on the latest research and management actions performed.

#### *Regional level – reference group*

At the regional level we will establish a reference group for communication and feedback on our ideas, methods and preliminary results. This reference group will consist of management personnel from several of the national authorities and stakeholder organizations directly involved. We have been given a preliminary approval by the following persons and organizations; Christer Pettersson, SEPA; Maria Falkevik and Johanna Wikland, County Administrative Board of Värmland and Örebro; Krister Kadell, Swedish Forest Agency; Gunnar Glöersen, Swedish Association for Hunting and Wildlife Management; Michael Larsson, Storaenso, and Mats Forslund, WWF. This group also acknowledge that these questions will be given high priority by the research community.

#### *Local level – public meetings*

At the local level we will annually arrange information events where the public can take part of our results, ask questions, and discuss our approach and findings. All three applicants are also regularly invited to present our research at meetings arranged by for example local hunting organizations and public information events. The main applicant of this proposal are responsible and initiative takers for a high number of publications and public information events. During the last two years the three applicants have together participated, and often led, more than 100 information events ranging from single hunting districts to conservation groups and meetings with regional and national management authorities.

Finally, at the Skandulv website there is currently >300 publications listed including results from the research project and which most are available as downloadable documents. These publications includes research results ranging in type from pure peer-review articles, to reports and investigations as assigned by national management authorities to Skandulv, and finally to popular science articles. This diverse and well established network of communication channels linked to the proposed research project in combination with the reference group and arrangements of public meetings will assure an involvement of stakeholders and the public during the project.

#### References

<sup>1</sup>Miljösmål. <http://www.miljomal.se/>

<sup>2</sup>Naturvårdsverket 2015. Strategi för svensk viltförvaltning, Naturvårdsverket, Stockholm.

<sup>3</sup>Westling A 2015. Rödlistade arter i Sverige 2015. ArtDatabanken SLU, Uppsala.

<sup>4</sup>European Union's Council Directive 92/43/EEC.

<sup>5</sup>Naturvårdsverket 2015. Delredovisning av regeringsuppdraget att utreda gynnsam bevarandestatus för varg (M2015/1573/Nm).

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## Budget

### Salaries including social fees

Role in the project	Name	Percent of salary		
1 Applicant	Håkan Sand	50		
2 Participating researcher	Camilla Wikenros	25		
3 Participating researcher	Johan Månsson	8		
Total				

	2017	2018	2019	Total
1	350,000	350,000	350,000	1,050,000
2	153,000	153,000	153,000	459,000
3	60,000	60,000	60,000	180,000
Total	563,000	563,000	563,000	1,689,000

### Dedicated time for this project

Role in the project	Name	Percent of full time		
1 Applicant	Håkan Sand	50		
2 Participating researcher	Camilla Wikenros	25		
3 Participating researcher	Johan Månsson	8		

### Running Costs

Running Cost	Description	2017	2018	2019	Total
1 Resekostnader	Deltagare i referensgruppen, totalt 5 möten	60,000	30,000	30,000	120,000
2 Open Acces kostnad	5 planerade publikationer	15,000	30,000	30,000	75,000
3 Resekostnader	Deltagande i 2 internationella konferenser		30,000	30,000	60,000
Total		75,000	90,000	90,000	255,000

(1) - Materiel etc. refers to equipment and other research materiel not classified as fixed assets, e.g. chemicals, literature, and software.

### Equipment depreciation costs

Depreciation cost	Description	2017	2018	2019
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## Premises

Type of premises	2017	2018	2019	Total
1 Kontorslokal	90,000	90,000	90,000	270,000
Total	90,000	90,000	90,000	270,000

## Total Budget

Specified costs	2017	2018	2019	Total, applied	Other costs	Total cost
1 Salaries including social fees	563,000	563,000	563,000	1,689,000		1,689,000
2 Running costs	75,000	90,000	90,000	255,000		255,000
3 Depreciation costs				0		0
4 Premises	90,000	90,000	90,000	270,000		270,000
5 Subtotal	728,000	743,000	743,000	2,214,000	0	2,214,000
6 Indirect costs	241,000	241,000	241,000	723,000		723,000
7 Total project cost	969,000	984,000	984,000	2,937,000	0	2,937,000

## Budget specification (max 7000 characters)\*

### Salaries

All members of the research team will have an active role in all activities throughout the project.

Håkan Sand – will in total work with this project to 50% of his full time (applied salary: 50% per year). Salary is applied for accordingly at a rate of 462 000 SEK per full time year with LKP of 51.50%, overheads of 42.87% and rent of 15.98%. Håkan Sand will be the coordinator of the scientists and stakeholders involved in the project.

Camilla Wikenros – will in total work with this project to 25% of her full time (applied salary: 25% per year). Salary is applied for accordingly at a rate of 403 200 SEK per full time year with LKP of 51.50%, overheads of 42.87% and rent of 15.98%.

Johan Månsson – will in total work with this project approximately to 8% of his full time (applied salary: 8.3% per year). Salary is applied for accordingly at a rate of 471 600 SEK per full time year with LKP of 51.50%, overheads of 42.87% and rent of 15.98%.

### Travel costs

We apply to pay travel costs and one night of housing for the reference group meeting (including stakeholders and end users): 1-2 meetings/year, 10 persons, 30 000 (60 000) SEK/year (two meetings the first year). The travel costs to other meetings will be covered by other funders and will not add any costs to the budget of the project.

We calculate with costs for 2 international conferences in both 2018 and 2019. Expected cost 30 000 SEK each year.

### Open Access publication costs

We expect to publish at least 5 scientific publications from this project and calculate with a total publication cost of 75 000 SEK for Open Access (i.e., an average cost of 15 000 SEK/paper).

## **Ethics**

**Animal testing**

**Human testing**

**Classifications**

**Subject area (min/max 1 subject area)\*** 52. PROGRAMOMRÅDE SKOGSBRUK O NATURMILJÖ > 5203. 23.1  
Biologisk mångfald

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**SCB-codes (min 1, max 3 SCB-codes)\*** 10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity  
Conservation

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**Keyword 1\***

sustainable use

**Keyword 2**

predation

**Keyword 3**

biodiversity

**Keyword 4**

forest management

**Keyword 5**

harvest

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Appendices

Appendix J. Illustrations. If figures, tables or images are needed to describe the project, an appendix may be uploaded here. The total size of the attachments can be maximum 4 MB in the formats jpg, png or gif

Appendix J

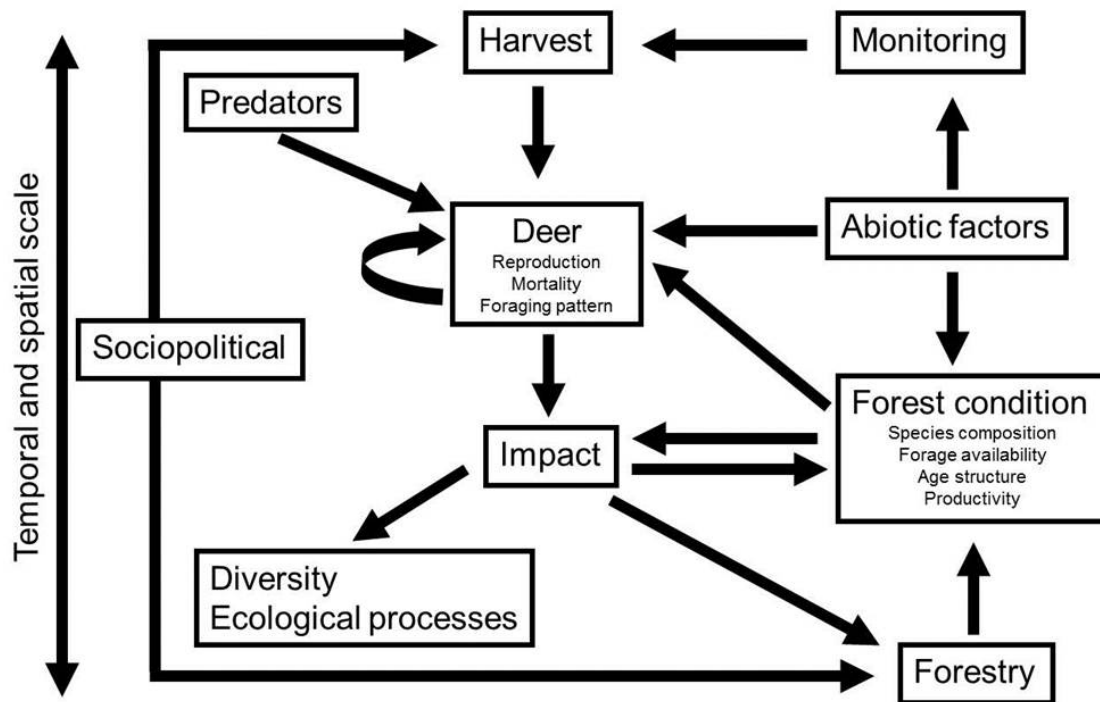


Figure 1. The figure show components, processes and management of the Swedish forest ecosystem. From Månsson 2007. PhD thesis, SLU.

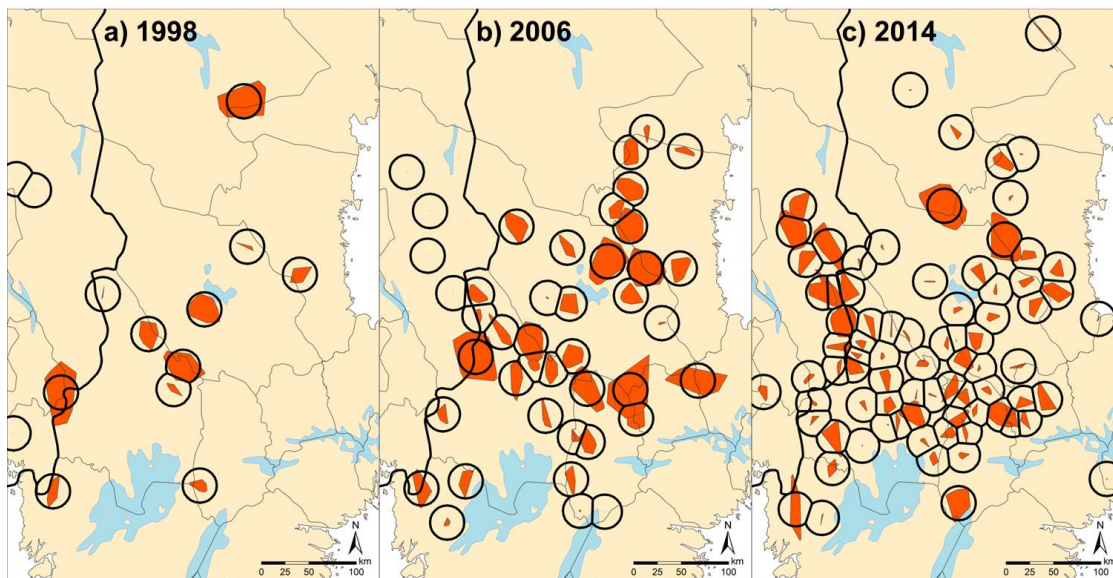


Figure 2. Approximate distribution of wolf territories and their spatial range as extrapolated from monitoring data from three winters during the wolf recolonization phase in Sweden. Red polygons represent actual observations made during the census season whereas black circles represent an assumed realized range of the wolf territory.



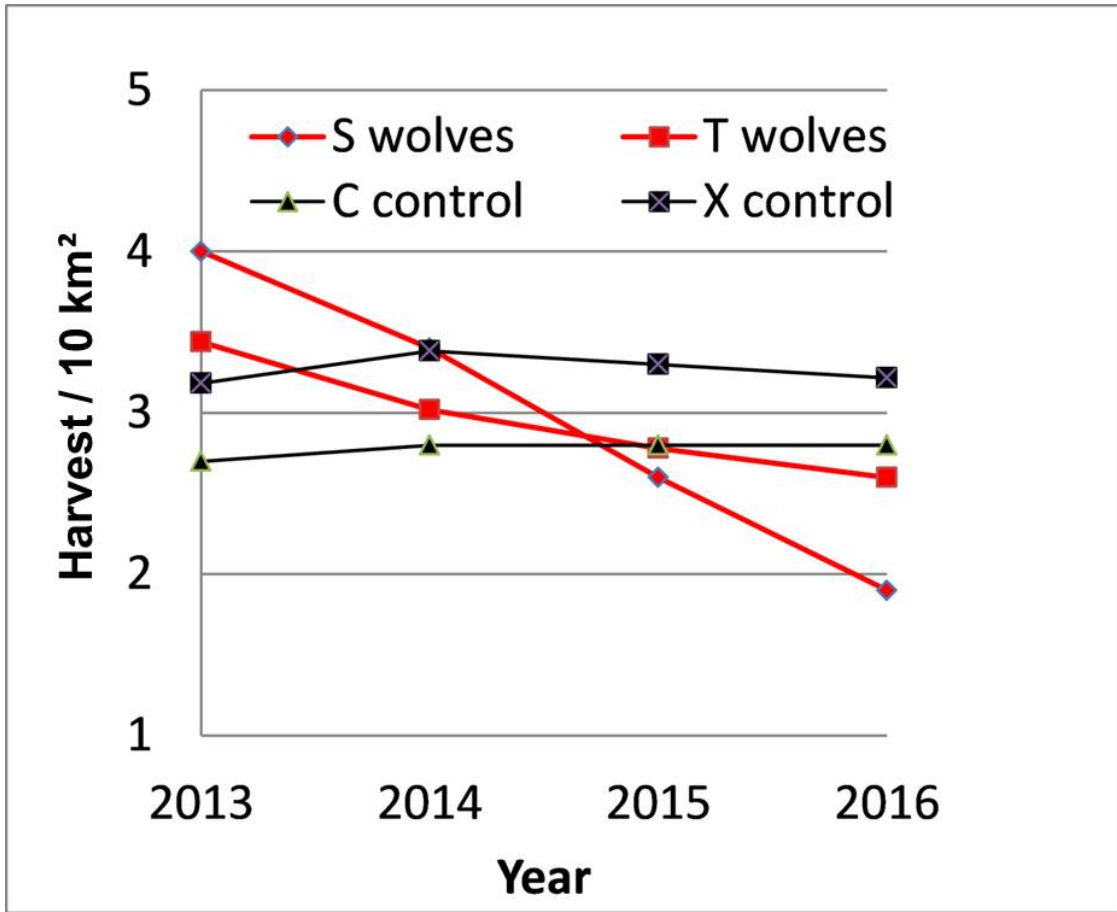


Figure 3. Harvest data on moose (number shot per 10 km<sup>2</sup>) for two counties (Värmland (S) and Örebro (T)) with high density and with long duration of wolves (red lines) and similar data from two counties (Gävleborg (X) and Uppsala (C)) without wolves (black lines) for the 2013-2016 period.

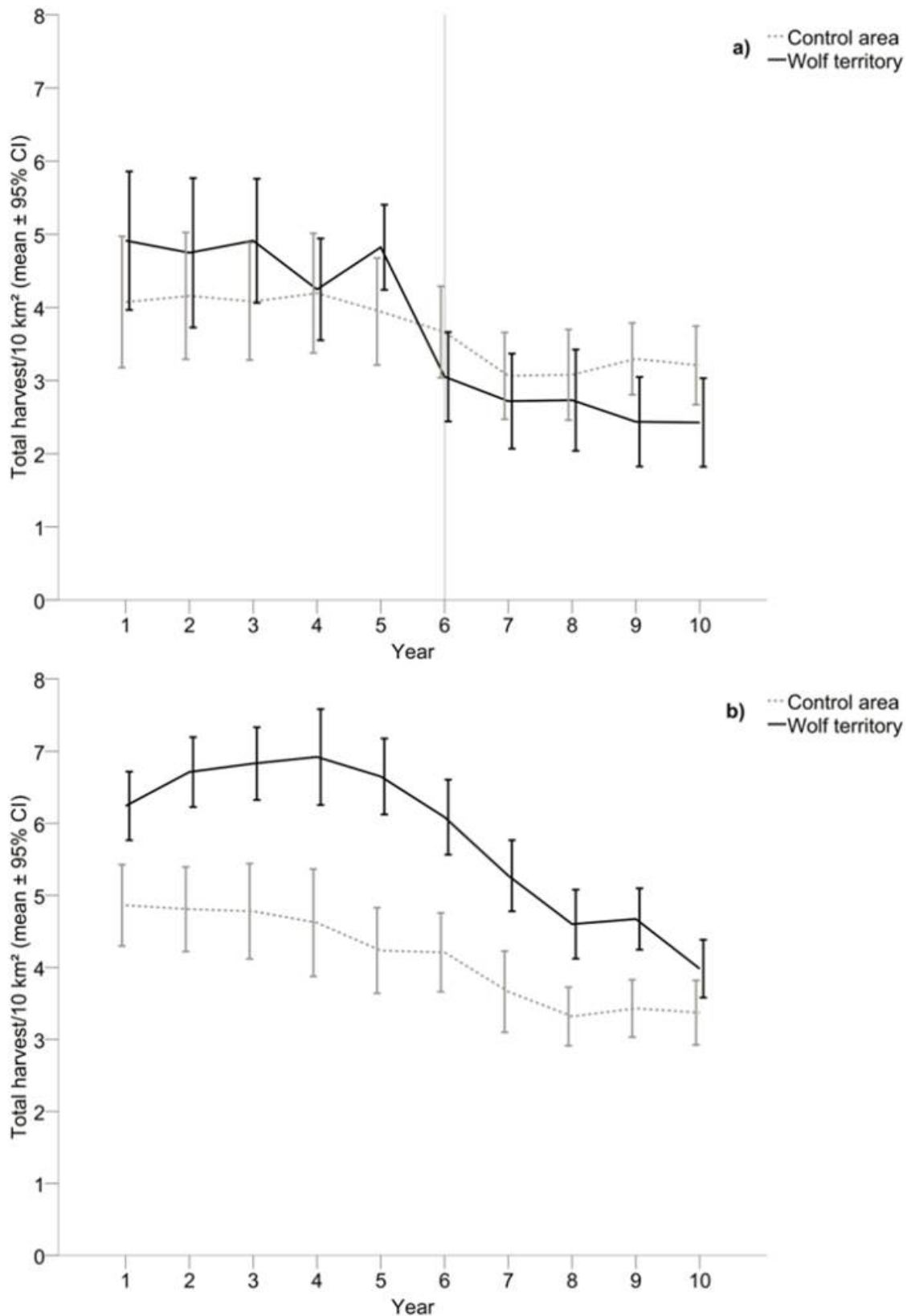


Figure 4. Harvest of moose within wolf territories compared to control areas. Total harvest of moose (males, females and calves pooled) during a) five years prior to wolf establishment and five years with wolf presence, and b) ten years with presence of wolves. The vertical line in a) indicates the first year with wolf presence. From Wikenros et al. 2015. PLoS ONE.



Figure 5. The location of Grimsö Wildlife Research Area (left map). The study area (right map, black line) includes data from VHF/GPS-collared moose. Locations of moose and winter activity areas are shown as an example for 15 of the collared moose. The borders of the Grimsö Wildlife Research Area (dotted line) and distribution of 600 sample plots (evenly dispersed along the perimeter of 1x1 km site (dots)) that are surveyed annually for ungulate pellet groups and browsing damage are also shown on the right map.

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Appendix K. Climate and environmental data (The [form for the publication of data](#) that is available from the ECDS (Environment Climate Data Sweden) must be used.)

### Appendix K

No file has been attached

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# CV

## CV - Håkan Sand

**Name:** Håkan Sand  
**Birthdate:** 19610506  
**Gender:** Male  
**Country:** Sweden

**Doctorial degree:** 1996-05-08  
**Academic title:** Docent  
**Employer:** Sveriges lantbruksuniversitet

## Educational history

### Research education

Examination	Organisation	Dissertation title (en)
Doctors degree, 10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, 1996-05-08	Swedish University of Agricultural Sciences, Ekologi	Life history variation in moose ( <i>Alces alces</i> ): geographical and temporal variation in body growth and reproduction

### Basic education

Year	Examination
1988	10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, Degree of Bachelor, Stockholm University

## Professional history

### Employments

Period	Position	Part of research in employment	Employer
april 2008 - Present	Researcher, Permanent employment	100	Swedish University of Agricultural Sciences, Ekologi
april 1996 - april 2008	Researcher, Permanent employment	100	Swedish University of Agricultural Sciences, Ekologi
april 1990 - april 1996	PhD student, Temporary employment	80	Swedish University of Agricultural Sciences, Ekologi

### Interruptions in research

Period	Description
2004-01-01 - 2004-04-30	Parental leave 100%
2000-09-01 - 2001-02-28	Parental leave 100%

## Merits and awards

### Docentur

Year	Subject	Organisation
2008	106. Biological Sciences (Medical to be 3 and Agricultural to be 4)	Swedish University of Agricultural Sciences, Ekologi

### Supervised persons

Supervised persons	Role	Number
Student	Secondary supervisor	4

Supervised persons	Role	Number
PhD student	Secondary supervisor	2
Student	Main supervisor	24
Postdoc	Main supervisor	3
PhD student	Secondary supervisor	2

Research grants awarded in competition					
Period	Funder	Project leader	Your role	Sub amount (SEK)	Total amount (SEK)
2015 - 2017	Naturvårdsverket	Håkan Sand	Applicant	0	3600000
2012 - 2014	Naturvårdsverket	Håkan Sand	Applicant	0	5700000
2009 - 2011	Naturvårdsverket	Håkan Sand	Applicant	0	6600000
2006 - 2008	European Union (EU)	Håkan Sand	Applicant	0	3000000
2006 - 2008	Marie Claire Cronstedts Stiftelse	Håkan Sand	Applicant	0	8800000
2006 - 2008	Naturvårdsverket	Håkan Sand	Applicant	0	5800000
2005 - 2008	Formas	Olof Liberg	Co-applicant	0	1530000
2004 - 2007	Formas	Håkan Sand	Applicant	0	1580000
2002 - 2005	European Union (EU)	Henrik Andrén	Co-applicant	0	8000000
1998 - 2014	Svenska Jägareförbundet	Håkan Sand	Applicant	0	2275000

Other merits		
Period	Type of merit	Description
1990 - 2016	Bibliometrics: total / last 5 years	Peer-review: 43/17, Citations: 1347 (in total, Web of Science 2016-04-13), H-index (Web of Science 2016-04-13): 20, Technical reports: 36/15, Book chapters: 4/2, Popular science articles: 55/40, Conference presentations: 26/6, Debate articles: 5/3.
1996 - 2016	Experience of disseminating results to stakeholders/end users	I perform oral presentations and seminars 15-20 times per year (in total 200-250) for groups organized by for example the Swedish Environmental Protection Agency, County Administrative Boards (including Wildlife Management Delegations), Swedish Association of Hunting and Wildlife Management, Swedish Carnivore Association, Swedish Association for Nature Conservation, private forestry companies (Storaenso AB, SCA Skog, Mellanskog), Studieförbundet, Friluftsförbundet, Kolmårdens Djurpark, and Rovdjurscentrum (Järvsö). Active annual participation in the national Wolf Symposium in Vålådalen, 2000-2013 (not 2004 due to parental leave).
1998 - 2016	Project leader	Project leader of the Scandinavian Wolf Research Project (SKANDULV) 1998-2017. Project leader of the study: Relationship between wolves-moose-forest at the Grimsö Wildlife Research Area 2007-2012. Project leader of the EU-project: New technology for wildlife research 2006-2008. Project leader of the research project: Seals and Fisheries 1997.
2005 - 2016	Collaboration with personal invitation by management authorities	I am invited to discuss questions focused on wolf management by Swedish Environmental Protection Agency (2-3 times per year), County Administrative Boards (5 counties (S, W, T, X, U), 3-4 times per year), Ministry of Environment (3 times). For example: hearing about immigration and behaviour of wolves, Swedish Environmental Protection Agency, Stockholm (Dec 2010); wolf harvest models, Swedish Environmental Protection Agency (Sept 2009, May 2015); seminar organized by the Swedish Environmental Protection Agency on science based criteria for "favourable reference population" of the Scandinavian wolf population" (Aug 2015).
2003 - 2016	Commissions of trust	Opponent at the PhD-dissertation of Hege Gundersen, University of Oslo, 2003, Oslo, Norway. Member of the evaluation committee at the PhD-dissertation of Susanne Sylvén, SLU, 2005, Uppsala, Sweden. Member of the evaluation committee at the PhD-dissertation of Wiebke Neumann, SLU, 2009, Umeå, Sweden. Actively engaged in a number of referral treatment made by Swedish University of Agricultural Sciences.

Period	Type of merit	Description
1999 - 2016	Media coverage	TV: Documentary film (Vargen - Hatad, Älskad, Buggad av Henrik Ekman) produced and broadcasted by the Swedish Television 2010, Mitt i Naturen, and Myror i brallan. Radio: Naturmorgon, Vetenskapsradion, and regional radio (Radio Dalarna, P4 Dalarna, Gävleborg, Örebro etc.). Newspapers: approximately 20 interviews annually resulting in articles regarding results from the Scandinavian Wolf Research Project in national and regional newspapers and magazines.
2009 - 2015	Meetings with personal invitations	Selection of invitations: KVA (Royal Academy of Sciences), Stockholm (2011); Workshop organized by WWF on large carnivores (May 2011); WWF-workshop: ecology of large carnivores, Hamar, Norge (2009); Norwegian Deer Management Congress, Trondheim (2014).
2000 - 2016	Referee for international scientific journals	BMC Ecology, Ecography, Ecology Letters, Ecosphere, Journal of Applied Ecology, Oecologia, Oikos, The University Chicago Press, Wildlife Biology.
2012 - 2016	Popular science (11 selected of 55)	Sand H, et al. 2012. Strategier för beskattning av älg. FaktaSkog SLU, Nr. 24-2011. Sand H, et al. 2012. Flera jägare på älgpopulationen. FaktaSkog SLU, Nr. 25-2011. Sand H, et al. 2012. Beskattning av älgpopulationer med varg och björn. FaktaSkog SLU, Nr. 26-2011. Sand H., et al. 2012. Är skandinaviska vargar mer blodtörstiga? FaktaSkog SLU, 6-2012. Sand H., et al. 2014. Hur stora revir har vargarna ? FaktaSkog SLU, 6-2014. Sand H., et al. 2014. Vad påverkar predationsrisken för älg och rådjur? FaktaSkog SLU, 7-2014. Sand H. et al. 2014. Varför Skandinaviens vargar dödar fler älgar. Svensk Jakt 6-2014. Sand H. et al. 2014. Vargar väljer älgar i sämre kondition än vad jägarna gör! Hjorteviltet, Norge. Sand H, et al. 2015. Strategier för beskattning av älg med och utan rovdjur. Hjorteviltet, Norge. Sand H et al. 2015. Hur påverkas avskjutningen av älg vid etablering av varg? Faktaskog, Nr 8, 2015, SLU. Sand H, et al. 2015. Flera jägare i skogen ? Medlemstidning Mellanskog 2:9-11.
2008 - 2013	Assignments	Responsible and/or co-author of 13 assignments from the Swedish Environmental Protection Agency (density-dependent dispersal distances of Scandinavian wolves, an updated synthesis on appropriate science-based criteria for "favourable reference population" of the Scandinavian wolf population, population estimates for the Scandinavian wolf population and sample-based monitoring etc.), 2 from the Norwegian Environment Agency (sammansättning av kunskapsläget från det skandinaviska vargforskningsprojektet SKANDULV (2010, 2014)), 1 from WWF (2011), 2 from SOU (1999, 2007), and 1 from SLU (2012).
2008 - 2016	Technical reports (3 selected of 36)	1. Wabakken P, Sand H, et al. 2015. Density-dependent dispersal distances of Scandinavian wolves. Report to the Swedish Environmental Protection Agency.; 2. Liberg O, Chapron G, Wikenros C, Flagstad Ø, Wabakken P, and Sand H. 2015. Bilaga 2 "Joint statement från syntes-författarna" och bilaga 3 "An updated synthesis on appropriate science-based criteria for "favourable reference population" of the Scandinavian wolf (Canis lupus) population" i "Delredovisning av regeringsuppdraget att utreda gynnsam bevarandestatus för varg (M2015/1573/Nm)". Rapport från Naturvårdsverket, NV-02945-15.; 3. Chapron G, Wikenros C, Liberg O, Svensson L, Åkesson M, Månsson J, Zimmermann B, Milleret C, Wabakken P, and Sand H. 2015. Population estimates for the Scandinavian wolf population and sample-based monitoring – development of a new method. Rapport från Viltskadecenter, SLU 2015-5.

## CV - Camilla Wikenros

**Name:** Camilla Wikenros  
**Birthdate:** 19730618  
**Gender:** Female  
**Country:** Sweden

**Doctorial degree:** 2011-12-21  
**Academic title:** Doktor  
**Employer:** Sveriges lantbruksuniversitet

## Educational history

Research education		
Examination	Organisation	Dissertation title (en)
Doctors degree, 10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, 2011-12-21	Swedish University of Agricultural Sciences, Ekologi	The return of the wolf – effects on prey, competitors and scavengers

## Basic education

Year	Examination
2002	10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, Degree of Master, Uppsala universitet

## Professional history

### Employments

Period	Position	Part of research in employment	Employer
januari 2015 - Present	Researcher, Permanent employment	55	Swedish University of Agricultural Sciences, Ekologi
december 2012 - december 2015	Researcher, Temporary employment	30	Swedish University of Agricultural Sciences, Ekologi
december 2011 - juni 2012	PhD student, Temporary employment	50	Swedish University of Agricultural Sciences, Ekologi
november 2005 - november 2011	PhD student, Temporary employment	80	Swedish University of Agricultural Sciences, Ekologi
januari 2002 - oktober 2005	Research assistant, Temporary employment	0	Swedish University of Agricultural Sciences, Ekologi

### Post doctoral assignments

Period	Organisation	Subject
juli 2012 - november 2012	Mammal Research Institute of the Polish Academy of Sciences	10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation

### Interruptions in research

Period	Description
2010-11-01 - 2010-11-30	Parental leave, 25%
2010-09-01 - 2010-10-31	Parental leave, 50%
2009-09-10 - 2010-08-31	Parental leave, 100%

## Merits and awards

### Supervised persons

Year	Supervised persons	Role
2017	Postdoc, Mariano Recio, Sveriges lantbruksuniversitet	Secondary supervisor
2015	Licentiate, Robert Weimer, Sveriges lantbruksuniversitet	Secondary supervisor
2015	Student, Maike Demski, Uppsala universitet	Main supervisor
2014	Student, Jessica Hansson, Högskolan i Halmstad	Secondary supervisor
2012	Student, Lea Baronnat, University of Montpellier	Secondary supervisor
2012	Student, Cyril Milleret, Université Joseph Fourier Grenoble	Secondary supervisor
2012	Student, Janneke Scholten, University of Applied Sciences HAS Den Bosch	Secondary supervisor
2012	Student, Gyöngyvér Balogh, Sveriges lantbruksuniversitet	Main supervisor
2010	Student, Anders Hedlund, Sveriges lantbruksuniversitet	Secondary supervisor
2007	Student, Lisette Fritzon, Linköpings universitet	Secondary supervisor
2005	Student, Hannah Windsor, University of Reading	Secondary supervisor

## Research grants awarded in competition

Period	Funder	Project leader	Your role	Sub amount (SEK)	Total amount (SEK)
2015 - 2016	Sweden - Higher education institutions	Camilla Wikenros	Applicant	0	776000
2015 - 2017	Naturvårdsverket	Håkan Sand	Co-applicant	0	3670000
2016 - 2017	Carl Tryggers Stiftelse	Håkan Sand	Co-applicant	0	276000

## Other merits

Period	Type of merit	Description
2002 - 2016	Bibliometrics	Past 5 year period / In total: H-index (Scopus 2016-04-12): 6; Peer-reviewed journals: 7/11 (with an additionally 7 under review/revision of which 2 as first author); Citations in peer-reviewed journals: 132 (80 without self-citations, Scopus 2016-04-12); Book chapters: 2/2; Technical reports (based on assignments): 8/9; International conference abstracts/contributions: 8(1 as invited speaker)/16; Popular science articles: 18/26; National popular science oral presentations: 34/90
2016 - 2016	Experience of disseminating results to stakeholders/end users	I perform educational presentations on a regular basis for the Wildlife Management Delegations of the County Administrative Boards (including members representing hunters, farmers, foresters, conservation NGOs, eco-tourism, politicians etc.). I give talks at meetings organized by SLU (mainly the Wildlife Damage Centre), the Swedish Association of Hunting and Wildlife Management, Swedish Carnivore Association, Swedish Association for Nature Conservation, and the annual Wolf Symposium in Vålådalen, and students (from middle school to university classes). I organize (since 2014) a three-day workshop on behalf of the Scandinavian Wolf Research Project (SKANDULV) where besides researchers, representatives from the ministries of environment, central managing authorities, regional management, forestry, hunting organizations, and nature conservation organizations attends. I have designed and I am the administrator of the SKANDULV website ( <a href="http://www.slu.se/skandulv">http://www.slu.se/skandulv</a> ).
2011 - 2016	Meetings with central and regional managers	Invited speaker for the governmental interrogations on large carnivores (November 2011).; Personal invitations by the Swedish Environmental Protection Agency to attend meetings regarding: monitoring of wolves (October 2013), ethics and policy of data handling and access from GPS-collared animals (January 2015), population size estimates for wolves (March 2014, April 2015), large carnivore harvest models (May 2015, March 2016 (invited by the County Administrative Boards)), favourable reference population size of wolves in Sweden (August 2015).
2014 - 2016	Coordination of research group	Coordinator of the Scandinavian Wolf Research Project (SKANDULV), ongoing (half time). This role includes coordinating the research project that includes 15 researchers in both Sweden and Norway (SLU, Hedmark University College, NINA), and being the contact person with managers in both Sweden and Norway, stakeholders, media, as well as national and international research groups.
2005 - 2015	Press coverage	Approximately 70 interviews of which 24 during 2015 resulting in articles in national (Aftonbladet, Svenska Dagbladet etc.) and regional newspapers (Bergslagsbladet, Bergslagsposten, Kristianstadsbladet, Nerikes Allehanda, Skaraborgs Allehanda etc.) and magazines (Jaktjournalen, Jakt & Jägare, Svensk Jakt, WWF panda planet, Våra Rovdjur etc.), national (Ekman H. 2010. Vargen den jagade jägaren. Norstedts förlag) and international books (Mills S. 2004. Tiger. Firefly Books (U.S)), as well as in radio (Radio Dalarna, P4 Nyheter Gävleborg, Jämtland, Örebro) and TV (Mitt i Naturen (SVT, 2008), Vargen – hatad, älskad, buggad (SVT documentary, 2009)). Four press-releases has been released in 2010-2013 resulting in a number of national (Jaktjournalen, Lantbruk & Skogsland etc.) and regional prints (Karlskoga KURIREN, Hällekis-Kuriren etc.) as well as web articles (Forskning & Framsteg, Jakt & Jägare, Norrbottens KURIREN, Vetenskapens värld etc.).



Period	Type of merit	Description
2013 - 2016	Commissions of trust	Opponent of doctoral dissertation, Erling L. Meisingset, Aug 25, 2015, University of Oslo, Norway, dissertation title: Space use of red deer and its implications for management.; Chairman (April 2013-January 2014) of a Swedish-Norwegian working group (9 members from both countries) designated of the Swedish Environmental Protection Agency and Norwegian Environment Agency to evaluate the current and alternative wolf monitoring systems and propose a coordinated wolf monitoring system in Sweden and Norway.; Consultation response (May 2014): "Remiss av förslag om ändringar i Naturvårdsverkets föreskrifter och allmänna råd (NFS 2007:10) om inventering av björn, varg, järv, lodjur och kungsörn samt förslag till ny metodik för inventering av björn och varg".
2013 - 2016	Reviewer for scientific journals	8 times: Acta Theriologica, Canadian Journal of Zoology, Current Zoology, Folia Zoologica, Mammalian Biology, Proceedings of the Royal Society B, Wildlife Biology.
2015 - 2015	Assignments	Assignments from the Swedish Environmental Protection Agency to the Scandinavian Wolf Research Project (SKANDULV) during 2015 in which I have been involved: 1. "Population estimates for the Scandinavian wolf population and sample-based monitoring – development of a new method" (main responsibility); 2. "An updated synthesis on appropriate science-based criteria for "favourable reference population" of the Scandinavian wolf (Canis lupus) population" (co-author); 3. "Density-dependent dispersal distances of Scandinavian wolves" (co-author).
2011 - 2016	Popular science texts (8 selected of 26)	1. Sand H, och Wikenros C. 2015. Hur påverkas avskjutningen av älg vid etablering av varg? Fakta Skog 8, SLU 2. Sand H, Wikenros C, och Månsson J. 2015. Strategier för beskattning av älg med och utan rovdjur. Hjorteviltet:72-77 3. Sand H, och Wikenros C. 2015. Flera jägare i skogen – vad är fakta om vargens predation? Medlemstidning Med Mellanskog 2:9-11 4. Kjellander P, Sand H, Andreassen H, André n H, Elmhagen B, Ericsson G, Linnell JDC, Mikusinski G, Mysterud A, Månsson J, Persson J, Solberg EJ, Thulin C-G, Wabakken P, og Wikenros C. 2014. Ulv og biologisk mangfold. Hjorteviltet:24-25 5. Wikenros C, Sand H, Wabakken P, och Liberg O. 2014. Aningslösa älgar vid vargattacker. Hjorteviltet:78-80 6. Sand H, Wikenros C, och Liberg O. 2014. Skandinaviens vargar dödar fler älgar. Svensk Jakt 6:62-65 7. Wikenros C. 2012. Vargens återkomst – effekter på bytesdjur, konkurrenter och asätare. Fauna & Flora 107:20-24 8. Wikenros C, Sand H, och Liberg O. 2011. Varg bra för andra arter? Miljöforskning No. 4.
2016 - 2016	Technical reports (4 selected of 9)	1. Wabakken P, Sand H, Andreassen HP, Maartmann E, Åkesson M, Flagstad Ø, Liberg O and Wikenros C. 2015. Density-dependent dispersal distances of Scandinavian wolves. Report to Swedish Environmental Protection Agency.; 2. Liberg O, Chapron G, Wikenros C, et al. 2015. Bilaga 2 "Joint statement från syntes-författarna" och bilaga 3 "An updated synthesis on appropriate science-based criteria for "favourable reference population" of the Scandinavian wolf (Canis lupus) population" i "Delredovisning av regeringsuppdraget att utreda gynnsam bevarandestatus för varg (M2015/1573/Nm)". Rapport från Naturvårdsverket.; 3. Chapron G, Wikenros C, et al. 2015. Population estimates for the Scandinavian wolf population and sample-based monitoring – development of a new method. Viltskadecenter, SLU.; 4. Wikenros C, et al. 2014. Förslag till samordning av inventering av varg i Norge och Sverige. NINA Report.
2016 - 2016	Examiner of master thesis	Andreasson J. 2015. Home range size and movement patterns of female lynx (Lynx lynx) during the yearly survey period in reindeer husbandry area. Master thesis, SLU 2015: 1.

## CV - Johan Månsson

**Name:** Johan Månsson  
**Birthdate:** 19760714  
**Gender:** Male  
**Country:** Sweden

**Doctorial degree:** 2007-10-12  
**Academic title:** Docent  
**Employer:** Sveriges lantbruksuniversitet

## Educational history

### Research education

Examination	Organisation	Dissertation title (en)
Doctors degree, 10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, 2007-10-12	Swedish University of Agricultural Sciences	Moose management and browsing dynamics in boreal forest

### Basic education

Year	Examination
2001	10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation, Degree of Master of Science in Forestry, Swedish University of Agricultural Sciences

## Professional history

### Employments

Period	Position	Part of research in employment	Employer
juli 2009 - Present	Researcher, Permanent employment	60	Swedish University of Agricultural Sciences
juli 2009 - juli 2013	Assistant professor, Temporary employment	100	Swedish University of Agricultural Sciences
september 2000 - maj 2002	Research assistant, Temporary employment	100	Swedish University of Agricultural Sciences

### Post doctoral assignments

Period	Organisation	Subject
januari 2008 - juli 2009	Swedish University of Agricultural Sciences, Vilt, fisk och miljö	10611. Ecology incl. Aquatic Ecology, Terrestrial Ecology, Biodiversity Conservation

## Merits and awards

### Docentur

Year	Subject	Organisation
2013	106. Biological Sciences (Medical to be 3 and Agricultural to be 4)	Swedish University of Agricultural Sciences, Ekologi

### Supervised persons

Year	Supervised persons	Role	Number
2016	Postdoc, Andrés Ordiz, Sveriges lantbruksuniversitet	Secondary supervisor	
2016	PhD student, Lovisa Nilsson, Sveriges lantbruksuniversitet	Main supervisor	
2014	Postdoc, Kerry Nicholson, Sveriges lantbruksuniversitet	Secondary supervisor	
	Student	Secondary supervisor	8
	Student	Main supervisor	12
	Student	Main supervisor	3

### Research grants awarded in competition

Period	Funder	Project leader	Your role	Sub amount (SEK)	Total amount (SEK)
2016 - 2018	Formas	Johan Månsson	Applicant	0	3500000

Period	Funder	Project leader	Your role	Sub amount (SEK)	Total amount (SEK)
2015 - 2017	Naturvårdsverket	Håkan Sand	Co-applicant	0	3670000
2014 - 2016	Marie-Claire Cronstedts stiftelse	Håkan Sand	Co-applicant	0	240000
2013 - 2017	Naturvårdsverket	Johan Månsson	Applicant	0	350000
2012 - 2014	Carl Tryggers stiftelse	Håkan Sand	Co-applicant	0	240000
2011 - 2013	Marie-Claire Cronstedts stiftelse	Johan Månsson	Applicant	0	225000
2009 - 2011	Naturvårdsverket	Gunnar Jansson	Co-applicant	0	990000
2009 - 2011	Naturvårdsverket	Anders Jarnemo	Co-applicant	0	800000
2009 - 2011	KSLA	Anders Jarnemo	Co-applicant	0	199000
2006 - 2010	Marie-Claire Cronstedts stiftelse	Håkan Sand	Co-applicant	0	1018000

### Other merits

Period	Type of merit	Description
2002 - 2016	Bibliometrics	Past 5 year period / In total. Peer-reviewed journals: 16/25 (with an additionally 4 under review/revision); Citations in peer-reviewed journals (Scopus 20160412): 212 (169 without self-citations); H-index (Scopus 20160412): 8; Books and chapters: 2/7; Technical reports: 19/31; International conference abstracts/contributions: 6/11; Popular science articles: 18/30; National popular science oral presentations: ~100/160 (about 20 per year the last 5 years).
2002 - 2016	Technical reports (5 out of 31)	1. Frank, J, Månsson, J., and Zetterberg, A. 2016. Viltskadestatistik 2015. Grimsö: Viltskadecenter, SLU 2016-1. 2. Ericsson G., Edenius L., Roberge J.-M., Månsson J., Cromsigt J., Singh N. och Neumann W. 2013. Slutrapport, temaforskningsprogram Vilt och Skog 2010-2012. Sveriges Lantbruksuniversitet, inst.Vilt, Fisk och Miljö, Rapport 3. 3. Jarnemo A. & Månsson J. 2011. Barkskalning av kronvilt: en fråga om födotillgång, landskapstyp eller populationstäthet? Slutrapport viltvårdsfonden, projektnummer 09/214 V-205-09. Naturvårdsverket, Stockholm. 4. Månsson J., Levin M., Larsson I. & Ängsteg I. 2010. Besiktning av skador på gröda orsakade av vildsvin. Viltskadecenter, SLU. 5. Månsson, J., Ericsson, G., and Bergström, R. 2008. Projekt viltbete och foderproduktion – inventeringsresultat 2008. Klövviltsindex, betestryck och skadegrad. Resultatrapport 1. Department of Wildlife, Fish, and Environmental. Studies, SLU.
2002 - 2016	Popular sciences (5 out of 30)	1. Kjellander, P., Sand, H., Andreassen, H. Andrén, H., Elmhagen, B., Ericsson, G., Linnell, J.D.C., Mikusinski, G., Mysterud, A., Månsson, J., Persson, J., Solberg, E.J., Thulin, C-G., Wabakken, P., and Wikenros, C. 2014. "För att påverka naturen krävs minst 4.000 vargar". DN Debatt: 6. 2. Månsson J., Roberge J.-M., Edenius L., Bergström R., Nilsson L., Komstedt K., Lidberg M. & Ericsson G. 2012. Viltåkrar – foderproduktion och indirekta effekter på skogen. Fakta Skog Nr 15. 3. Månsson, J, Jansson G., Lindblom S. & Levin M. 2011. Skador av vildsvin - omfattning och fördelning i ett mellansvenskt jordbrukslandskap. Faktablad från Viltskadecenter 2010-4. SLU. 4. Månsson, J., Hake M., Nilsson L., Wiberg A. & Levin M. 2010. Förslag på arbetsmodell för att lösa problem med betande fåglar. Faktablad från Viltskadecenter 2010-05. SLU. 5. Månsson, J., Andrén, H., Bergström, R., Kjellander, P., Pehrson, Å. and Kalén, C. 2007. Älgbete i tid och rum - vad styr älgarna och betestrycket i ungskog? Fakta Skog nr 7.
2010 - 2010	Opponent	Opponent of doctoral dissertation. Floris van Beest, Factors affecting the spatiotemporal distribution of moose. Nov 12, 2010, University of Oslo, Norway.
2014 - 2014	Evaluation committee	Evaluation committee licentiate thesis. Michael Manton, Managing green infrastructures, trophic interactions in anthropogenic and natural ecosystems. Dec 16, 2014, Swedish University of Agriculture Sciences, Uppsala, Sweden.
2007 - 2016	Reviewer for scientific journals	Reviewer for ~15 scientific journals e.g. Animal conservation, Conservation biology, Journal of applied ecology, Journal of wildlife management, Ecosphere, Scandinavian Journal of Forest Research.

Period	Type of merit	Description
2011 - 2016	Examiner of master and bachelor thesis	Linda Höglund, 2016 Factors affecting timing of seasonal migration by roe deer. Master thesis. Department of Ecology, SLU. Tina Cederholm, 2012. Use and competition at artificial feeding sites – The roe deer and fallow deer case. Bachelor thesis. Department of Ecology, SLU. Petra Walander, 2012. Six years of estimating roe and fallow deer density with distance sampling at the Koberg estate. Bachelor thesis. Department of Ecology, SLU. Pablo Garrido, 2011. Deer browsing on Norway spruce in relation to supplemental feeding – not a matter of distance only. Master thesis. Department of Ecology, SLU. Elin Grönberg, 2011. Evaluating six crop mixes used for game fields in southwest Sweden - biomass production, fallow deer preference and species diversity. Master thesis. Department of Ecology, SLU.
2008 - 2014	Committee experience, commissions and governmental inquiries	2014 Government commission – writing main texts of the government commission: "Riktlinjer för åtgärder och ersättningar/bidrag för skador i odlingslandskapet av stora fåglar". 2013 Referral response on government inquiry – responsible for the referral response on the government inquiry: "Vargkommitténs betänkande - Åtgärder för samexistens mellan människa och varg" 2009-2010 Member of committee within the commission to develop "National management plan for Wild boar", Swedish Environmental Protection Agency. Head of commission: Christer Pettersson, Swedish Environmental Protection Agency. 2009 Member of committee arranging the National forestry congress "Skogskonferensen". Head of group: Åke Lindelöw, Dept. of Ecology. 2008-2009 Member of committee with the commission to develop "wildlife adapted forestry", Swedish Forestry Board. Head of commission: Christer Kalén, Swedish Forestry Board.
2012 - 2014	Coordinator of the Scandinavian Wolf Research Project	Coordinator of the Scandinavian Wolf Research Project (SKANDULV), 2012-2014 (half time). The research project involves 15 researchers in Sweden and Norway. This role includes coordinating the research project in both Sweden and Norway (SLU, Hedmark University College, NINA), and being the contact person with managers in both Sweden and Norway, stakeholders, media, as well as national and international research groups.

## Publications

### Publications - Håkan Sand

<b>Name:</b> Håkan Sand	<b>Doctorial degree:</b> 1996-05-08
<b>Birthdate:</b> 19610506	<b>Academic title:</b> Docent
<b>Gender:</b> Male	<b>Employer:</b> Sveriges lantbruksuniversitet
<b>Country:</b> Sweden	

#### Scientific publication - peer-reviewed

##### Original journal article

**Title:** Predator-dependent functional response in wolves: from food limitation to surplus killing  
**Authors:** Barbara Zimmermann, Hakan Sand, Petter Wabakken, Olof Liberg, Harry Peter Andreassen  
**Date of publication:** 2015      **Volume:** 84      **Issue number:** 1  
**Name of journal:** JOURNAL OF ANIMAL ECOLOGY  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Testing the risk of predation hypothesis: the influence of recolonizing wolves on habitat use by moose  
**Authors:** Kerry Nicholson, Cyril Milleret, Johan Månsson, Håkan Sand  
**Date of publication:** 2014      **Volume:** 176      **Issue number:** 1  
**Name of journal:** Oecologia  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Sharing the bounty-Adjusting harvest to predator return in the Scandinavian human-wolf-bear-moose system  
**Authors:** Niclas Jonzen, Hakan Sand, Petter Wabakken, Jon E. Swenson, Jonas Kindberg, Olof Liberg, Guillaume Chapron  
**Date of publication:** 2013                      **Volume:** 265      **Issue number:**  
**Name of journal:** ECOLOGICAL MODELLING  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Decomposing risk: Landscape structure and wolf behavior generate different predation patterns in two sympatric ungulates  
**Authors:** Vincenzo Gervasi, Håkan Sand, Barbara Zimmermann, Jenny Mattisson, Petter Wabakken, John Linnell  
**Date of publication:** 2013                      **Volume:** 23      **Issue number:** 7  
**Name of journal:** Ecological Applications  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Comparing body condition of moose selected by wolves and human hunter's: consequences for the extent of compensatory mortality  
**Authors:** Håkan Sand, C. Wikenros, Per Ahlqvist, Thomas H Strømseth, Petter Wabakken, Camilla Wikenros  
**Date of publication:** 2012                      **Volume:** 90      **Issue number:** 3  
**Name of journal:** Canadian Journal Of Zoology-Revue Canadienne De Zoologie  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Shoot, shovel and shut up: cryptic poaching slows restoration of a large carnivore in Europe  
**Authors:** Olof Liberg, Guillaume Chapron, Håkan Sand  
**Date of publication:** 2012                      **Volume:** 279      **Issue number:** 1730  
**Name of journal:** Proceedings Of The Royal Society B-Biological Sciences  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Predicting the potential demographic impact of predators on their prey: a comparative analysis of two carnivore-ungulate systems in Scandinavia  
**Authors:** Vincenzo Gervasi, Erlend B. Nilsen, Håkan Sand, Manuela Panzacchi, Geir Rune Rauset, Hans C. Pedersen, Jonas Kindberg, Petter Wabakken, Barbara Zimmermann, John Odden, Olof Liberg, Jon E. Swenson, John D. C. Linnell  
**Date of publication:** 2012                      **Volume:** 81      **Issue number:** 2  
**Name of journal:** Journal Of Animal Ecology  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Assessing the influence of prey-predator ratio, prey age structure and pack size on wolf kill rate  
**Authors:** Håkan Sand, John Vucetich, Barbara Zimmermann, Petter Wabakken, Camilla Wikenros, Hans-Christian Pedersen, Peterson Rolf, Olof Liberg  
**Date of publication:** 2012                      **Volume:** 121      **Issue number:** 9  
**Name of journal:** Oikos  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Building a mechanistic understanding of predation with GPS-based movement data  
**Authors:** Evelyn Merrill, Håkan Sand, Barbara Zimmermann, Heather McPhee, Nathan Webb, Mark Hebblewhite, Petter Wabakken, Jacqueline Frair  
**Date of publication:** 2010                      **Volume:** 365      **Issue number:** 1550  
**Name of journal:** Philosophical Transactions Of The Royal Society B-Biological Sciences  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Summer kill rates and predation pattern in a wolf-moose system  
**Authors:** Håkan Sand, Petter Wabakken, Barbara Zimmermann, Örjan Johansson, Hans C. Pedersen, Olof Liberg, Barbara Zimmerman, O Johansson  
**Date of publication:** 2008                      **Volume:** 156      **Issue number:** 1  
**Name of journal:** Oecologia  
**Academic publication - peer-reviewed:** Original journal article

## Publications - Camilla Wikenros

<b>Name:</b> Camilla Wikenros	<b>Doctorial degree:</b> 2011-12-21
<b>Birthdate:</b> 19730618	<b>Academic title:</b> Doktor
<b>Gender:</b> Female	<b>Employer:</b> Sveriges lantbruksuniversitet
<b>Country:</b> Sweden	

Scientific publication - peer-reviewed

### Original journal article

**Title:** Behavioural responses of ungulates to indirect cues of an ambush predator  
**Authors:** Camilla Wikenros, Dries P.J. Kuijper, Robert Behnke, Krzysztof Schmidt  
**Date of publication:** 2015                      **Volume:** 152      **Issue number:** 7-8  
**Name of journal:** Behaviour  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Response of Moose Hunters to Predation following Wolf Return in Sweden  
**Authors:** Camilla Wikenros, Håkan Sand, Roger Bergström, Olof Liberg, Guillaume Chapron  
**Date of publication:** 2015                      **Volume:** 10      **Issue number:** 4  
**Name of journal:** PLoS ONE  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Movement pattern of red deer during drive hunts in Sweden  
**Authors:** Anders Jarnemo, Camilla Wikenros  
**Date of publication:** 2014                      **Volume:** 60      **Issue number:** 1  
**Name of journal:** European Journal Of Wildlife Research  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Feeding under high risk of intraguild predation: vigilance patterns of two medium-sized generalist predators  
**Authors:** Camilla Wikenros, Sophie Ståhlberg, Håkan Sand  
**Date of publication:** 2014                      **Volume:** 95      **Issue number:** 4  
**Name of journal:** Journal Of Mammalogy  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Biomass Flow and Scavengers Use of Carcasses after Re-Colonization of an Apex Predator  
**Authors:** Camilla Wikenros, Håkan Sand, Per Ahlqvist, Olof Liberg  
**Date of publication:** 2013                      **Volume:** 8      **Issue number:** 10  
**Name of journal:** PLoS ONE  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Assessing the influence of prey-predator ratio, prey age structure and pack size on wolf kill rate  
**Authors:** Håkan Sand, John Vucetich, Barbara Zimmermann, Petter Wabakken, Camilla Wikenros, Hans-Christian Pedersen, Peterson Rolf, Olof Liberg  
**Date of publication:** 2012                      **Volume:** 121      **Issue number:** 9  
**Name of journal:** Oikos  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Competition between recolonizing wolves and resident lynx in Sweden  
**Authors:** Camilla Wikenros, Olof Liberg, Håkan Sand, Henrik Andren  
**Date of publication:** 2010      **Volume:** 88      **Issue number:** 3  
**Name of journal:** Canadian Journal Of Zoology-Revue Canadienne De Zoologie  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Wolf predation on moose and roe deer: chase distances and outcome of encounters  
**Authors:** Camilla Wikenros, Håkan Sand, Petter Wabakken, Olof Liberg, Hans C. Pedersen  
**Date of publication:** 2009      **Volume:** 54      **Issue number:** 3  
**Name of journal:** Acta Theriologica  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Cross-continental differences in patterns of predation: will naive moose in Scandinavia ever learn?  
**Authors:** Håkan Sand, Camilla Wikenros, Olof Liberg, P Wabakken  
**Date of publication:** 2006      **Volume:** 273      **Issue number:** 1592  
**Name of journal:** Proceedings Of The Royal Society B-Biological Sciences  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Effects of hunting group size, snow depth and age on the success of wolves hunting moose  
**Authors:** Håkan Sand, Camilla Wikenros, Petter Wabakken, Olof Liberg  
**Date of publication:** 2006      **Volume:** 72      **Issue number:** :  
**Name of journal:** Animal Behaviour  
**Academic publication - peer-reviewed:** Original journal article

## Publications - Johan Månsson

<b>Name:</b> Johan Månsson	<b>Doctorial degree:</b> 2007-10-12
<b>Birthdate:</b> 19760714	<b>Academic title:</b> Docent
<b>Gender:</b> Male	<b>Employer:</b> Sveriges lantbruksuniversitet
<b>Country:</b> Sweden	

Scientific publication - peer-reviewed

## Original journal article

**Title:** Food plots as a habitat management tool: forage production and ungulate browsing in adjacent forest  
**Authors:** Johan Månsson, Jean-Michel Roberge, Lars Edenius, Roger Bergström, Lovisa Nilsson, Maria Lidberg, Karl Komstedt, Göran Ericsson  
**Date of publication:** 2015      **Volume:** 21      **Issue number:** 5  
**Name of journal:** Wildlife Biology  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Browsing and damage inflicted by moose in young Scots pine stands subjected to high-stump precommercial thinning  
**Authors:** Lars Edenius, Johan Månsson, Tobias Hjortstråle, Jean-Michel Roberge, Göran Ericsson  
**Date of publication:** 2015      **Volume:** 30      **Issue number:** 5  
**Name of journal:** Scandinavian Journal Of Forest Research  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Managing landscapes for multiple objectives: [Elektronisk resurs]  
**Authors:** Anders Jarnemo, J Minderman, Nils Bunnefeld, Josefina Zidar, Johan Månsson, Johan Mansson  
**Date of publication:** 2014      **Volume:** 5      **Issue number:** 8  
**Name of journal:** Ecosphere  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Bark-stripping on Norway spruce by red deer in Sweden: level of damage and relation to tree characteristics  
**Authors:** Johan Månsson, Anders Jarnemo  
**Date of publication:** 2013                      **Volume:** 28              **Issue number:** 2  
**Name of journal:** Scandinavian Journal Of Forest Research  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Spatial and temporal predictions of moose winter distribution  
**Authors:** Johan Månsson, Nils Bunnefeld, Henrik Andren, Göran Ericsson  
**Date of publication:** 2012                      **Volume:** 170              **Issue number:** 2  
**Name of journal:** Oecologia  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Felled Scots pine (*Pinus sylvestris*) as supplemental forage for moose (*Alces alces*): Browse availability and utilization  
**Authors:** Johan Månsson, Roger Bergström, Å Pehrson, M Skoglund, C Skarpe  
**Date of publication:** 2010                      **Volume:** 25              **Issue number:** 1  
**Name of journal:** Scandinavian Journal Of Forest Research  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Environmental variation and moose *Alces alces* density as determinants of spatio-temporal heterogeneity in browsing  
**Authors:** Johan Månsson  
**Date of publication:** 2009                      **Volume:** 32              **Issue number:** 4  
**Name of journal:** Ecography  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Fertilization-Effects on deciduous tree growth and browsing by moose  
**Authors:** Johan Månsson, Roger Bergström, Kjell Danell  
**Date of publication:** 2009                      **Volume:** 258              **Issue number:** 11  
**Name of journal:** Forest Ecology and Management  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Moose browsing and forage availability: a scale dependent relationship?  
**Authors:** Johan Månsson, Henrik Andrén, Åke Pehrson, Roger Bergström  
**Date of publication:** 2007-04-23              **Volume:** 85              **Issue number:**  
**Name of journal:** Canadian Journal of Zoology  
**Academic publication - peer-reviewed:** Original journal article

**Title:** Quantitative estimates of tree species selectivity by moose (*Alces alces*) in a forest landscape [Elektronisk resurs]  
**Authors:** Johan Månsson, H Smith, C Kalén, H Andrén, Petter Kjellander, Henrik Andren, Christer Kalen  
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## Register

### Terms and conditions

Ansökan ska förutom av den sökande även signeras av behörig företrädare för medelsförvaltaren. Företrädaren är vanligtvis prefekten vid den institution där forskningen ska bedrivas, men ska i vissa fall utgöras av exempelvis rektor. Detta framgår i sådana fall av den aktuella utlysningstexten för bidraget.

Signering av *den sökande* innebär en bekräftelse av att:



- uppgifterna i ansökan är korrekta och följer Formas instruktioner
- bisysslor och kommersiella bindningar har redovisats för medelsförvaltaren och att det där inte framkommit något som strider mot god forskningssed
- nödvändiga tillstånd och godkännanden ska finnas senast vid projektstart, exempelvis avseende etikprövning.

Signering av *medelsförvaltaren* innebär en bekräftelse av att:

- den beskrivna forskningen, anställningen och utrustningen kan beredas plats inom institutionen under den tid och i den omfattning som anges i ansökan
- institutionen godkänner kostnadsberäkningen i ansökan
- projektet bedrivs i enlighet med svensk lagstiftning.

Ovanstående punkter ska ha diskuterats mellan parterna innan företrädaren för medelsförvaltaren godkänner och signerar ansökan.

*Ansökningar där en organisation är sökande signeras automatiskt vid registrering av ansökan.*