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Snow cover characteristics and reindeer habitat selection

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1 – Aim

During late winter 2007, habitat selection by semi-domesticated reindeer was investigated in northern Finnish Lapland. As habitat selection reveals limiting factors in animal behavior, the aim was to evaluate the influence of different snow characteristics on habitat selection. A multi-scale approach was used to reveal patterns at different spatial extents.

2 – Methods

Snow depth, hardness, and density were recorded from mid-March until mid-April. Snow hardness was quantified by a Rammsond Penetrometer which measures the force required to break through the snow cover. Using a GIS, a continuous snow cover map was created as predictions for unsampled places were made for each location in the landscape based on the spatial arrangement of measured values and statistics of spatial autocorrelation ("cokriging"). Ranges of reindeer, as indicated by herders, were transferred to the GIS, so snow depth distribution could be analyzed in the respective ranges.

3 – Results

Reindeer digging displayed a threshold of 70 cm of snow depth. This behaviour reflects the selection for a shallower snow cover compared to adjacent sites. In those herding districts that displayed a highly heterogeneous snow depth, reindeer selected for shallower snow at progressively finer scales (Herding District – Range – Digging Crater). Possibilities for finding suitable digging patches are thus restricted by snow distribution at the larger scales.
Interactions with snow cover characteristics at digging craters were significant between snow hardness and snow depth. Hardness of snow decreased as snow depth increased. This trade-off reduces both time and energy necessary for digging activity to reach vegetation.

4 – Conclusions

Characteristics of snow cover contribute to habitat selection and condition of reindeer, as they have a considerable impact on energy expenditure and accessibility to forage. A region with diverse landscape patterns offers alternatives for reindeer to react to changing snow conditions over time. However, snow cover characteristics do not alone determine grazing value of patches or ranges. Information about further factors contributing to pasture conditions and grazing possibilities, e.g. habitat fragmentation and conflicts with other forms of land use are required to evaluate future management of pasture lands and reindeer. It remains difficult to assess in which way snow quantity and quality will change under the influence of recent climate change in both the short- and long term.

Snötäckets egenskaper och habitatval hos renar

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1 – Syfte
Under senvintern 2007 undersöktes habitatval hos renar in norra delen av finländska Lappland. Eftersom habitatval kan visa på begränsande faktorer för djurs beteenden var syftet med studien att utvärdera snötäckets påverkan. En flerskalig ansats användes för att undersöka mönster på olika spatiala skalor.

2 – Metoder
Snödjup, hårdhet och täthet mättes från mitten av mars till mitten av april. Snöhårdhet kvantifierades med en Rammsond Penetrometer som dokumenterar den kraft som behövs för att bryta genom snötäcket. En kontinuerlig karta över snödjupet konstruerades med hjälp av GIS genom att värden beräknades för varje position i området baserat på rumslig autokorrelation ("cokriging") av det mätta snödjupet. Betesområden för renarna, markerat på kartor av renskötarna, överfördes till GIS, så snödjup kunde undersökas i dessa områden.

3 – Resultat
Renars grävande uppvisade ett gränsvärde vid ca 70 cm snödjup där renarnar selekterade för tunnare snö jämfört med omgivningen. Inom skötselområden med ett varierande snödjup visade renar en preferens för tunnare snö när skalan minskades (skötselområde – betesområde – uppgrävd krater). Möjligheterna att hitta lämpliga platser för att gräva är därmed begränsade av den storskaliga snöfördelningen. Interaktioner mellan snöns hårdhet och snödjup var signifikant i de uppgrävda kratrarna: hårdheten minskade när djupet ökade. Denna kompromiss reducerar både den tid och energi som krävs för att gräva ner till vegetationen.

4 – Sammanfattning
Beskaffenheten av snötäcket bidrar till habitatvalet och konditionen hos renar eftersom den har en betydande effekt på energikonsumtionen och tillgången på foder. Områden med olika landskapsmönster erbjuder valmöjligheter för renar att svara på växlande snöbeskaffenhet. Men det är inte endast snötäckets egenskaper som begränsar ett områdes betesvärde. Information om andra faktorer behövs också, såsom t.ex. habitatfragmentering och konflikter med andra markanvändare, för att kunna bedöma det framtida användandet av ett betesområde. Det är fortfarande oklart hur snökvalitet och -kvantitet kommer att förändras i ett förändrat klimat på både kort- och lång sikt.

Reindeer husbandry in a climate change

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A questionnaire study on reindeer husbandry and climate change was performed to achieve the thoughts, concerns and conclusion of people with local knowledge working in the husbandry. The questionnaire consisted of climate scenario maps with weather variables relevant to the reindeer husbandry and was sent to 64 persons involved in reindeer herding from all parts of the Swedish reindeer herding area. They were asked to give personal reflections and predictions of the local conditions and how climate change would affect their local reindeer husbandry and prerequisites based on the given climate projections. In addition, there was room for the respondents to define local requirements for a continuously sustainable husbandry based on the presumed changes.
The reindeer herding was divided into 7 climate zones and a summary of the predicted climate changes for each area, excerpts from the questionnaire response, and climate scenario maps are presented in the poster.

Renskötsel i klimatförändring

För att samla tankar, farhågor, visioner och slutsatser angående renskötsel och klimatförändringar bland personer aktiva i renskötseln genomfördes en enkätundersökning. Enkäten bestod bl.a. av klimatkartor på vädervariabler som anses centrala för renskötseln och renproduktiviteten. Den skickades ut till 64 personer från hela renskötselområdet som på olika sätt är engagerade i renskötseln. Enkätdeltagarna ombads att anteckna personliga reflektioner och prognoser på hur de lokala förutsättningarna för renskötsel kan komma att ändras baserat på givna klimatprojektioner. Det gavs även utrymme för de svarande att identifiera behov för en fortsatt livskraftig renskötsel under pågående förändringar i klimat och i förutsättningar.
I enkäten delades renskötselområdet upp i 7 klimatzoner och en sammanfattning över klimatförändringarna för varje zon och utdrag från svaren på enkäten samt klimatkartorna presenteras i postern.

The key to the future is in the past: Adaptations of natural resource-based communities to climatic and societal changes – the case of Sami reindeer husbandry

Tim Horstkotte[1], Annette Löf[2], Isabelle Rönnqvist[3] & Åsa Össbo[3]
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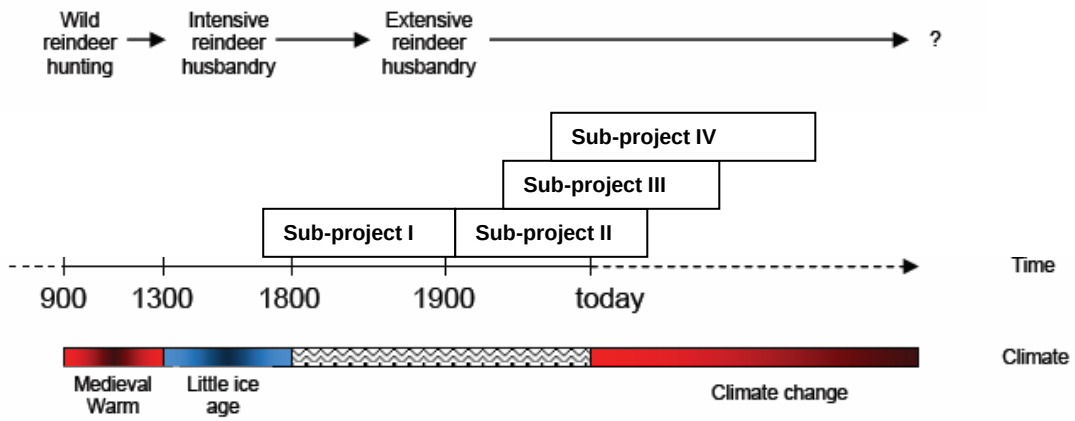
Knowledge about previous adaptations made by the Sami community to climatic and societal changes provides insight on the historical processes underlying reindeer herding practices today, and potential restrictions or opportunities of future adaptation options.
The multidisciplinary research group we represent will undertake four dissertations, interconnected by the overall goal to study climate adaptations in reindeer husbandry, situated in a socio-economic, ecological and political context. The aim is to identify "successes" and "failures" in adaptation to new conditions and disturbances of different types, in order to enhance the understanding of generic adaptation options to future projected changes. The PhD-projects share a common focus on resilience theory and adaptive capacity in social-ecological systems.



PhD-project I: Population dynamics and reindeer herding 1750 -1900

Isabelle Rönnqvist, Department of History

It is widely acknowledged that the Sami population exhibit historical demographic regimes that are quite distinct from those observed in the majority population. The demographic differences observed are often explained by long term effects due to State policies during the process of colonization. The impacts of climate change have never been implemented in the studies of population dynamics in the Sami areas. The project design includes longitudinal studies of migration, fertility and mortality that will be compared with climate reconstructions in order to answer the main question: how the adaptive capacity of the reindeer husbandry has been transformed during the 18th and 19th centuries. Changes in the legislative systems, the implementation of reindeer acts and relegations undertaken by the Swedish government frame the premises for the adaptive changes of the reindeer herders. They also form the foundation on which the study will build.

PhD-project II: Reindeer herding and hydroelectric exploitation

Åsa Össbo, Department of History

The aim of this study is to illuminate interaction between external, state influence and internal forces during large-scale landscape conversions of the twentieth century in the Sami area. By focusing on hydroelectric exploitation and its effect on reindeer husbandry the study will answer how the interest and knowledge of reindeer herders where taken account of by authorities, courts and power companies. What where the consequences on both short and long term basis, and how did herding adapt to these changes? Source material concerning individual hydropower projects will be used, as well as documents from the regional Sami administration *Lappväsendet* and Sami organizations such as Swedish Sami Association (SSR).

PhD-project III: Constraining effects of land use and climate change on reindeer winter pastures

Tim Horstkotte, Department for Ecology and Environmental Sciences

Climatic changes and land use conflicts result in far-reaching consequences and intricate constraints for reindeer husbandry. In particular, multiple-use of boreal forests leads to a depletion of lichen resources and alteration of the ecosystem, limiting the adaptive space of reindeer husbandry. Climate change impacts are likely to further confound the situation by altering snow conditions, as well as growing conditions of regenerating forests and lichen resources. The overarching aim for this project is to reveal patterns of current pressures that restrict the options for reindeer herders to adjust to future changes. Furthermore the study will provide scenarios, on which decisions can be made to face predicted changes. Landscape analyzes will help to evaluate the risk of ice-crust formation on winter pastures in dependence of forestry methods and the grazing values of different forest stand characteristics and of various protection forms.

PhD-project IV: Institutional dimensions on climate change adaptation in reindeer husbandry

Annette Löf, Department of Political Science

This PhD-project will explore institutionally conditioned adaptation opportunities to climate change in the multi-level governance system of Swedish reindeer husbandry. Step one is to analyse how the capacity to deal with different types of climate change (slow *and* fast, local *and* large-scale) is diversified across institutional levels – from local to international (focusing on state and reindeer herding district levels) – and how this has varied over time (e.g. with technological development and through institutional learning processes). A thick definition of institutions will be applied, including formal regulation and informal norms and "praxis". The aim is to tease out, using comparative case studies and data from qualitative interviews, policy documents and consultation protocols, what factors enable efficient adaptation at one level (or by one actor) and how this capacity can either be complemented or constrained by capacities of, or actions undertaken by, actors at other horizontal and vertical levels.

Caribou movements in West Greenland. Studies in relation to proposed industrial development

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Short communication:

Introduction

There are plans to establish an aluminium smelter in Maniitsoq including the construction of hydropower plants and transmission lines, roads and other infrastructure encompassing a large area between Nuuk and "Sukkertoppen Iskappe" in West Greenland. This area also holds the important caribou herd south of "Sukkertoppen Iskappe", the Akia-Maniitsoq herd.

Caribou are one of the most valued hunting object or nature values in Greenland and local residents are concerned about negative impacts from the proposed construction of hydropower plants and associated infrastructure, including construction and operation of reservoirs.

The existing knowledge about caribou in the region is not continuous in season, time and space (Tamstorf *et al*., 2005). This was the background for a satellite tracking project, where collars with transmitters were put on 40 female caribou in the spring of 2008. The project provided a direct method of studying migration routes and movements of caribou. This will allow follow-up and assessment of the potential effects on caribou from the construction activities and infrastructure. Also, data obtained by the proposed projects will make it possible to predict where the most important caribou ranges are located by combining data from satellite collars, vegetation maps and terrain models.

Objectives

In a recent Norwegian literature review (Reimers & Colman, 2006), the authors conclude that usually caribou leave areas with human activities, however only within a relatively short distance from the activities. The authors assess that the energetic cost of avoidance is relatively small compared to cost of escaping from natural disturbances like the harassment from insects. The effects of physical installations are largest when they are connected with human activities. Although increased caribou activity which means decreased time for foraging or rumination and increased utilization of fat depots, the effects of human activities are difficult to discriminate from natural variations in range use and population dynamics. The objectives of the study are to provide:

1) A solid foundation for studying and documenting present caribou range use. Potential effects from the aluminium smelter project on critical or core ranges and migration routes can be studied and documented before, during and after the construction phase by equipping caribou with new satellite transmitters.
2) The study provides a direct method to follow individual caribou on a daily basis. A well documented basis for assessing where the most important caribou areas (critical and core ranges) are located.
3) Knowledge of present migration routes in details not documented before.

Collar deployment

Collars were deployed by the Greenland Institute of Natural Resources on female caribou over the entire region in order to provide data representative for the whole area. Collars are from two different manufacturers, 20 collars from each manufacturer: Telonics Inc. in USA, who provides data via Argos and VECTRONIC Aerospace GmbH in Germany, who provides data via the Iridium system. Both types provide GPS positions several times a day depending on the positions of the satellites receiving the data.

Preliminary results

The following presentation of results is based on positions acquired since deployment of transmitters from the beginning of May until Nov 4 for the Iridium transmitters and until October 31 for the Argos transmitters. The presentation does not include scientific preparation of data. However, interesting

findings can already be presented and the report gives examples of these. A thorough examination of data will be included in the final reporting when all data and maps are available, presumably in 2010. Fig. 1 presents selections of positions for time periods corresponding to calving, and early winter, respectively.

Key findings – preliminary evaluation

Below is a list of key findings which shall be taken with caution as long as a thorough analysis has not yet been carried out. Up till now data show that most caribou move inland during May, although some caribou stay in the Akia area. However the most evident trend is that caribou stay inland during calving and during the summer until September, when they move south-west towards the coast. This becomes more evident during October, and by the end of October only few caribou stay inland while caribou now can be found very close to the coast.

Movements of individual caribou indicate a characteristic pattern: long periods (months) of residence in relatively restricted areas followed by long movements (10 to 40 km) over few days to a new area of longer residency. Data demonstrate a large variation, some individuals moving more than double the length travelled by the most inactive individuals. The general pattern of movements is in a direction from south-west to north-east in spring and the opposite direction in autumn. This pattern was also observed by the collaring team in May. Generally movements take place in the latter part of May, in the latter part of September and in the latter part of October.

Movements seem to take place over most of the area although there are preference for certain valleys. It is interesting that a wide belt in the northern part of the area has not been crossed by caribou. This might indicate that there are two caribou sub-populations in the area without much interaction. It is, of course, too early to conclude.

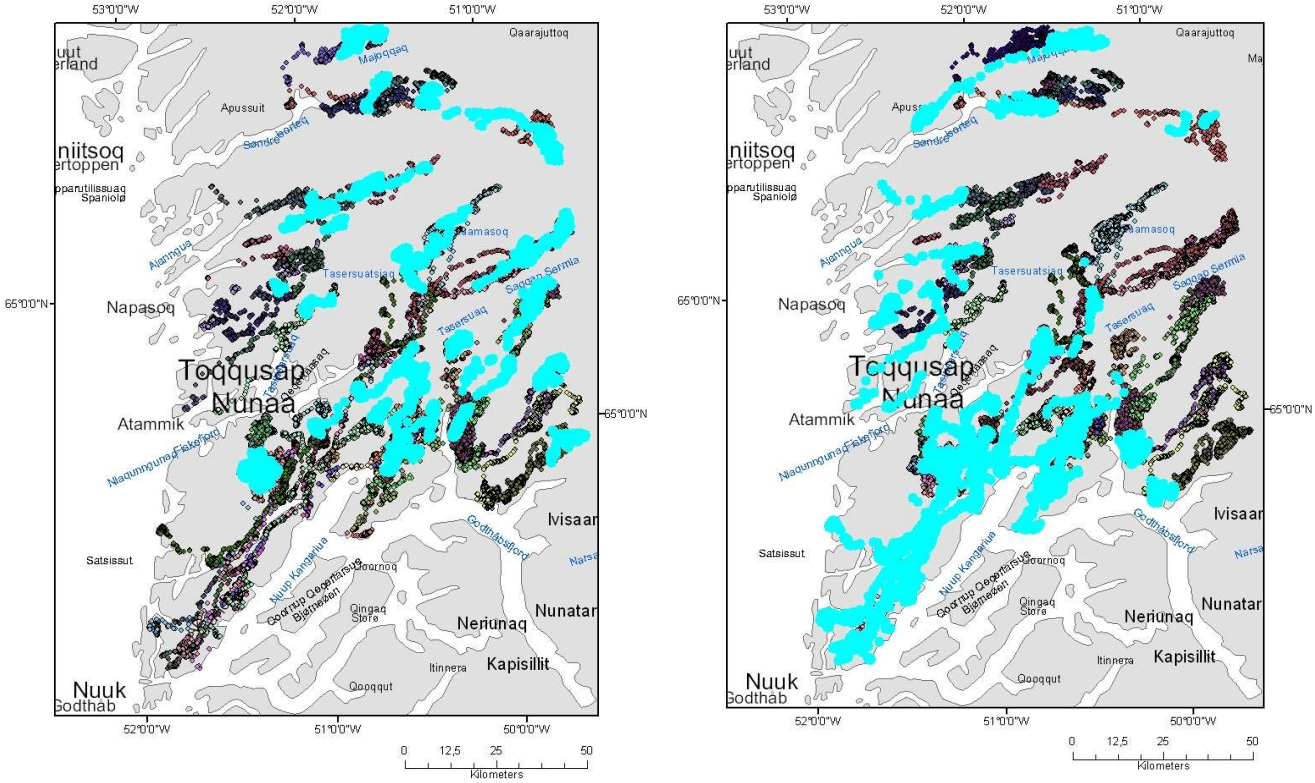

Fig. 1. Summary of caribou positions (highlighted with cyan) during calving May 25 to June 25 to the left. To the right caribou positions (highlighted with cyan) in autumn/early winter October 2008. The figure also shows all other locations to illustrate all movements during the study period.

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Revegetation in reindeer pastures after road and wind power plant construction in alpine, sub-arctic environments

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Anthropogenic activities and industrial development in alpine and northern regions are increasing, and anticipated to continue rapidly during the next 30 to 50 years. Infrastructure connected with industrial installations (e.g. roads, hydroelectric power plants, windmill power plants, power lines) damages surface substrates and vegetative communities, i.e. reindeer pasture. Because of challenging climatic conditions in alpine and arctic environments, ecosystems are often less resilient to big destructions. Disturbances and damage to surface substrates and/or vegetative communities can be long lasting and difficult to repair. Various methods and plant materials exist for repairing vegetation. However, many of these are impractical or inappropriate for particular landscapes and environments. Through testing the use of both commercial sorts and specially developed local plants, we have improved certain native plant materials for revegetation use in climatic challenging localities. We tested the re-vegetation success and reindeer feeding choice for commercial seeds (a mixture of timothy (*Phleum pretense*), meadow fescue (*Festuca pratensis*), bluegrass (*Poa pratense*), common bentgrass (*Agrostis tenuis*), and white clover (*Trifolium repens*)) and five specially developed, local varieties of plants known to be eaten regularly by reindeer, (alpine bluegrass (*P. pratensis* ssp. *alpigana*) locality Krampenes, tufted hairgrass (*Deschampsia caespitosa*) Solovuobme, sheep fescue (*Festuca ovina*) Avzze and dwarf birch (*Betula nan*a) Stuorajavri). Experimental and control plots (5 m x 100 m = 500 m^2) in replicate were established along the access road to the Kjøllefjord wind power plant (opened in 2006) on the Dyfjord peninsula in Finnmark, Norway. Fieldwork was conducted during the summer season, and survival, colonization, and seeding potential were tested for all plots and plant species. Using grazing enclosures we also measured and compared plant production between our experimental plants and the existing, natural vegetation composed of ca 50% heath species (*Empetrum nigrum*, *Vaccinium myrtillus*, *V. uliginosum*, and *V. vitis-ideae)*, ca 25% grasses and half grasses (*Deschampsia flexuosa*, *Festuca ovina*, *Nardus stricta*, *Carex bigelowii* and *C. aquatilis*), and ca 25% lignoses (*Betula nana*, *Salix phylicifolia* and S. *herbacea).* In addition, we examined whether the newly vegetated sites were grazed by reindeer.
Our specially developed plants showed better survival and higher growth/production than the commercial material. Reindeer grazed the new established plots on numerous occasions in both 2007 and 2008. Revegetation clearly provided reindeer with an improved pasture following the disturbances caused by construction of the windmills and the access roads. Importantly, commercial seeds are sub-optimal for establishing new vegetation in sub-arctic, alpine areas such as the study area. Specially developed, local plant material was more successful in terms of healing reindeer pasture in damaged habitat.

Revegetering av reinbeite etter bygging av veier og vind-møllekraftverk i alpine, subarktiske områder

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Menneskelig og industriell aktivitet i alpine og nordlige regioner øker stadig og forventes å øke i enda 30 til 50 år. Bygging av vann- og vindkraftverk med infrastruktur, kraftledninger og veibygging m.m. skader og ødelegger jordsmonn og plantedekke i beiteland for reinsdyr. Grunnet hardt klima i alpine og arktiske områder blir skadene på økosystemet mer langvarige og dessuten vanskeligere å reparere. Ulike metoder for revegetering og også noe plantemateriale er utviklet tidligere, men det meste er ikke tilpasset alpine og arktiske forhold. Gjennom utvalg og testing har vi utviklet et spesielt plante-materiale fra stedegne og lokalt tilpassede arter (fjellrapp (*P. pratensis ssp. alpigana*) lokalitet Krampenes, sølvbunke (*Deschampsia caespitosa*) Solovuobme, sauesvingel (*Festuca ovina*) Avzze og dvergbjørk (*Betula nana*) Stuorajavrre). Spesialmaterialet er sammenlignet med kommersielt plantemateriale av timotei (*Phleum pratense*), engsvingel (*Festuca pratensis*), engrapp (*Poa pratensis*), engkvein (*Agrostis tenuis*) og kvitkløver (*Trifolium repens*). Forsøksruter av 1 m x 1 m og 5 m x 100 m ble anlagt langs anleggsveien til Kjøllefjord vindmøllekraftverk som ble åpnet i 2006. Det utviklede spesialmaterialet etablerte seg raskere, overvintret bedre og ga større produksjon enn det kommersielle plantematerialet. Spesialmaterialet ble også testet sammen med naturlig vegetasjon i beiteforsøk for rein. Den naturlige vegetasjonen bestod hovedsaklig av ca 50% lyngarter (krekling (*Empetrum nigrum*), blåbær (*Vaccinium myrtillus*), blokkebær (*V. uliginosum*) og tyttebær (*V. Vitis-ideae*), ca 25% gras- og starrarter (*Deschampsia flexuosa*), sauesvingel (*Festuca ovina*), finn-skjegg (*Nardus stricta*), stivstarr (*Carex bigelowii*) og nordlandsstarr (*C .aquatilis*) og ca. 25% lignoser (dvergbjørk (*Betula nana*), grønnvier (*Salix phylicifolia*) og musøre (S. *herbacea*). Her var rutestørrelsen 1 m x 1 m, og vi brukte beitebur av hønsenetting for å hindre at reinen beitet på halvparten av rutene. Spesialmaterialet ble beitet like godt eller bedre enn det naturlige plantebestandet og mye bedre enn det kommersielle plantematerialet på vårt studieområde. Revegeteringen ga reins-dyrene et bedre beitegrunnlag enn det de fikk av den naturlige vegetasjon på stedet.

Do windmill parks affect the feeding behaviour of free ranging semi-domestic reindeer?

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Many present sites for wind power plants in Scandinavia are found within important reindeer pastures. The development of wind power in Scandinavia has raised alarm amongst reindeer herdsmen who fear detrimental affects from windmills on their reindeers' foraging behaviour and area use, and thus, their livelihoods. We examined local, on-site feeding behaviour of free ranging semi-domestic reindeer (*Rangifer tarandus tarandus*) during summer in connection with the Kjøllefjord Windmill Park, opened in 2006 on the Dyfjord peninsula in Finnmark, Norway. We investigated whether the windmill park was a source of stress for the animals that could result in reduced feeding efficiency while reindeer were within or near the windmill park. Optimal utilization of summer pasture is vital for reindeer growth, survival and production. As a measurement of the animals' stress level while feeding and thus feeding efficiency, we tested the number of steps taken while feeding for mature female reindeer during two minute periods. We compared data for reindeer in the windmill park, at various distances away from the windmill park but on the Dyfjord peninsula and from a control area on an adjacent peninsula. We also compared data gathered from the pre-construction phase in 2005 and the following years until summer 2008. When testing the number of steps taken while feeding and comparing these between years and reindeer location, we aimed to control for important variables such as elevation, vegetation type and percent coverage, calf or no calf, weather, level of insect harassment and prevailing herding activities conducted by the herdsmen. The construction of access roads and human infrastructure is also claimed to increase the overall use of an area by humans following construction. In some cases, such an increase use by humans as a result of the infrastructure is worse for reindeer in terms of disturbance than the physical structures themselves. To investigate whether the Kjøllefjord Windmill Park increased the amount of human use of the Dyfjord peninsula, we conducted a survey amongst the local people in Kjøllefjord. Habituation toward windmill parks might occur over a relatively short time period, but this is likely dependent on the reindeers' motivation to use the area, the reindeers' exposure time towards the windmill park and the predictability and amount/strength of disturbance the windmill park may cause for the reindeer. However, human use of an area is more difficult to predict. We recorded a number of occasions when reindeer were provoked into full fright and flight reactions by humans walking in the study area. Potential ways for testing this data and comparing reindeer feeding behaviour amongst years and various locations, including other windmill parks, will be presented.

I hvilken grad påvirker vindmølleparker beiteadferd blant tamrein?

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Mange av vindmølleparkene som eksisterer i Skandinavia i dag befinner seg i stor grad i viktige beiteområder for reinsdyr. Utviklingen av vindkraft i Skandinavia har ført til at reineiere nå frykter for skadelige effekter fra vindmølleparkene. De frykter endring av dyrenes beiteadferd og arealbruk, med påfølgende svekkelse av sitt inntektsgrunnlag. Vi har undersøkt beiteadferden til frittbeitende tamrein (*Rangifer tarandus tarandus*). Undersøkelsen ble foretatt om sommeren i forbindelse med at Kjøllefjord vindmøllepark på Dyfjordhalvøya i Finnmark åpnet i 2006. Vi undersøkte hvorvidt vindmølleparken var en stressfaktor for dyrene som kunne resultere i redusert beiteeffektivitet når reinsdyrene var i eller nær vindmølleparken. Optimal bruk av sommerbeitet er nødvendig for reinsdyrenes vekst, overlevelse og reproduksjon. Som et mål på dyrenes stressnivå under beiting, og dermed beiteeffektivitet, sjekket vi antall steg en moden simle tok under beiting i perioder på to minutter. Vi sammenlignet data for reinsdyr med ulike avstander til vindparken med tilsvarende data samlet inn i et kontrollområde på en halvøy i nærheten. Det er også gjort sammenligninger med data samlet inn under anleggsfasen i 2005 og årene frem til sommeren 2008. Vi testet antall skritt tatt under beiting opp mot ulike år og posisjon. Samtidig kontrollerte vi andre viktige variabler som: høyde, vegetasjon type og dekningsgrad, med eller uten kalv, værforhold, nivå av insektplage og flokkaktivitet forårsaket av reineierne selv. Det har også blitt hevdet at byggingen av atkomstvei og tilhørende infrastruktur har ført til økt menneskelig bruk av reinens beiteområder. I noen tilfeller kan slike forstyrrelser være verre for reinsdyrene enn vindmøllekonstruksjonen i seg selv. For å finne ut av om bruken av Dyfjordhalvøya økte som en konsekvens av utbyggingen av vindmølleparken, ble det gjennomførte en spørreundersøkelse blant lokalbefolkningen i Kjøllefjord. Reinsdyrenes tilvenning til vindmølleparker kan skje over en relativt kort tidsperiode. Slik tilvenning er sannsynligvis avhengig av reinsdyrenes motivasjon til å bruke området, eksponeringstid, forutsigbarheten og styrken på forstyrrelsen fra vindmølleparken. Menneskelig bruk av et område er selvfølgelig vanskeligere å forutse. Under feltarbeidet ble det observert episoder hvor reinsdyr reagerte med frykt- og fluktreaksjon når mennesker befant seg i observasjonsområdet. Mulige måter å teste slike data, sammenligning av beiteadferd mellom år og lokaliteter samt inkludering av andre vindparker vil bli presentert.

Preliminarily results from a reindeer-hunter interaction study during the small-game hunt

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A new source of disturbance for the semi-domesticated reindeer in the Swedish mountain region may be the increased number of willow grouse (*Lagopus lagopus*) hunters in the early autumn. The willow grouse live in the willow thickets and the birch forest vegetation, where the reindeer preferably eat mushrooms in the second half of the summer. The hunting season starts on the 25th of August each year and in some areas the hunt is carried out over a large part of the reindeer autumn range. Preliminarily results from studies of the hunting season 2007 show tendencies towards disturbing effects from the hunting activities. After three days of hunt, the reindeer groups seem to be smaller and more divided than during the first day of the hunt. Using movement data from GPS-collars on reindeer and GPS on hunters and their dogs during three hunting seasons (2007-2009) will give us more information about the interaction between hunters and reindeer during the small-game hunt.

Preliminära resultat från en interaktionsstudie mellan ren och ripjägare under ripjaktspremiären

Dalripa och ren nyttjar ofta samma typ av habitat under den senare delen av sommaren, dalripa lever i björkskogs och videregionen, medan renen med fördel letar svamp i dessa områden under sensommaren och hösten. Jaktsäsongen på dalripa startar den 25 augusti varje år och i en del fjällområden sker jakten i nära anslutning till viktiga betesmarker för renen under den här perioden. Ripjakten kan därför vara en källa till störning för renarna som leder till att de kan få svårt att finna betesro. Preliminära resultat från jaktsäsongen 2007 visar efter tre dagars jakt att renarna verkar delas upp i mindre grupper och sprids över ett större område än innan jakten startade. Genom att utrusta både renar, jägare och deras hundar med GPS-sändare under tre jaktsäsonger (2007-2009) kan vi samla in mer detaljerade data kring hur renarna och jägarna interagerar under jakten.

Precautionary estimation of the depredation pressure and its consequences in the semi-domesticated reindeer population in Sweden

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Semi-domesticated reindeer (*Rangifer t. tarandus*) is the main prey of the Eurasian lynx (*Lynx lynx*) and the wolverine (*Gulo gulo*) in the reindeer herding area. They also constitute part of the food resources of brown bear (*Ursus arctos*), wolf (*Canis lupus*), golden eagle (*Aquila chrysteatos chrysteato*s) and even red fox (*Vulpes vulpes*) within the reindeer herding area.
By applying precautionary principles when estimating predator numbers, and due to inaccuracies of inventory methods, the depredation of the reindeer population, and thereby the consequences for reindeer husbandry, commonly tend to be underestimated. When assessing the consequences for the prey population, the precautionary principle should be the opposite, i.e. avoid the tendencies to underestimate the depredation pressure.
By using this opposite principle, the total depredation (excluding red fox) on semi-domesticated reindeer was estimated to between 45 000 and 50 000 killed animals. The calculations were based on predator population estimates or goals in the reindeer herding area in Sweden (600 lynx, 575 wolverine, 2300 brown bears of which 1000 in reindeer areas during spring and summer, 10 wolves and 1200 golden eagles), kill rates, diet compositions, energy requirements and assessed proportions used of killed prey, and finally, possible interactions between lynx and wolverine in prey use.
The depredation consequences for the productivity of reindeer husbandry were projected with an age-structured density-dependant dynamic model of the semi-domesticated reindeer population. With the recent approx. 260 000 reindeer in winter stock and maximum calf slaughter as harvest strategy (81% calves and around 9.5% adult females and males ≥ 1 y., respectively, in the harvest outtake) the depredation caused a decrease in the harvest from potentially 153 000 reindeer and 3700 tons of carcasses to between 67 000 and 77 000 harvested reindeer and 1600 to 1900 tons (46% to 52 % of potential production) within the estimated range of depredation. At the same time the distribution of slaughtered stock was altered to 77% calves, 9% females ≥ 1 y. and 14% males ≥ 1 y. Thus, the harvest volume decreased with 1800 to 2100 tons or 48% to 54%. Expressed in relation to the winter stock, the productivity decreased from potentially 14.4 kg to around 7 kg carcasses per head. The decrease corresponds to 1.7 times the number of reindeer killed by predators.
Besides the directly killed reindeer, the decrease in harvested surplus was caused by lower numbers of calves born due to changed herd structure (slightly more than 0.6 times the number of killed reindeer) and increased calf mortality due to killed mothers (slightly more than 0.1 times the number of killed reindeer). The mortality of adults decreased however with a number corresponding to 0.05 times the number of killed reindeer due to lower proportions of adults in the population.
With the estimated depredation, the reindeer population is clearly at danger. Collapses may be triggered by, among others, variation between years in productivity conditions, discontinuation of reindeer husbandry enterprises, uneven distribution of predators, and/or additional increase of predator populations. This may lead to extended collapses, which danger both the semi-domesticated reindeer population and, as a secondary consequence, the predator populations in the reindeer herding area.

Försiktighetsbaserad skattning av predationstrycket och dess konsekvenser i tamrenpopulationen i Sverige

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Tamrenar (*Rangifer t. tarandus*) är det huvudsakliga bytet för lo (*Lynx lynx*) och järv (*Gulo gulo*) samt utgör delar av födounderlaget för björn (*Ursus arctos*), varg (*Canis lupus*), kungsörn (*Aquila chrysteatos chrysteatos*) och även rödräv (*Vulpes vulpes*) inom renskötselområdet. Tillämpningar av den s.k. försiktighetsprincipen vid skattning av rovdjursantal samt möjliga osäkerheter i inventeringsmetoder för rovdjur tenderar till systematiska underskattningar av predationstrycket på bytespopulationen bör försiktighetsprincipen vara omvänd, d.v.s. undvika tendenser till underskattning tamrenpopulationen och därmed även konsekvenserna för renskötseln. Vid analyser av konsekvenser för av predationstrycket. Med en sådan ansats skattades den samlade predationen (exkl. rödräv) på tamren i Sverige till mellan 45 000 och 50 000 renar per år utifrån aktuella beståndsskattningar och -mål (600 lodjur, 575 järvar, 2300 björnar varav 1000 i rentäta områden under vår och sommar, 10 vargar och 1200 kungsörnar), predationstakter, dietsammansättningar, energibehov, uppskattade nyttjandegrader av byten och tänkbara samspel mellan lo och järv i bytesutnyttjande.
Predationens konsekvenser för renskötselns produktivitet beräknades med hjälp av en ålderstrukturerad täthetsberoende dynamisk modell av tamrenpopulationen. Med de senaste årens ca 260 000 renar i vinterstammen och maximal kalvslakt som slaktstrategi (81% kalvar och ca 9,5% vajor resp. handjur i slakten) orsakade predationen en minskning av slakten från potentiella 153 000 renar och drygt 3700 ton slaktkropp till mellan 67 000 och 77 000 slaktade renar och 1600 till 1900 ton inom det skattade predationsintervallet (mellan 46% och 52% av potentiell produktion). Samtidigt försköts slaktens sammansättning till 77% kalvar, 9% vajor och 14% handjur. Sammantaget minskade slaktvolymen med mellan 1800 och 2100 ton eller mellan 48% och 54%. Per capita sjönk produktiviteten från potentiella 14,4 kg till runt 7 kg producerad slaktkropp per ren i vinterstammen. Minskningen i antal slaktade renar motsvarar 1,7 ggr antalet rovdjursdödade renar. Denna nedgång berodde, förutom den direkta predationen, på minskat antal födda kalvar till följd av ändrad populationsstruktur (motsv. drygt 0,6 ggr antalet rovdjursdödade renar) och ökad kalvdödlighet p.g.a. att mödrar dödats av rovdjur (motsv. drygt 0,1 ggr antalet rovdjursdödade renar). Vuxendödligheten däremot minskade med motsvarande 0,05 ggr antalet rovdjursdödade renar p.g.a. lägre andel vuxna djur i populationen. Med de predationstryck som beräknats föreligga riskerar renpopulationen att kollapsa. Kollapser kan utlösas lokalt av årsmånsvariationer, nedläggning av renskötselföretag, ojämn rovdjursfördelning, ytterligare uppgång av rovdjurantalet m.m. Det kan leda till utbredda kollapser som äventyrar renpopulationen och i nästa steg även rovdjuren i renskötselområdet.

Growth and body mass development of artificially fed reindeer during winter

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Article:

Introduction

Some thousand reindeer are fed each winter in Sweden to reduce the levels of radiocaesium before slaughter (Åhman, 2005). Reindeer herders are economically compensated from the government for this feeding. The present project was made on commission from the Swedish Board of Agriculture to improve the basis for decisions about levels of compensation. The experiment, where reindeer were fed reindeer feed (pellets) during two months in late winter, showed that body mass and body size generally increased during feeding. More than sex weeks of feeding was, however, needed for all reindeer to increase their body mass.

Material and methods

The experiment was carried out in northern Sweden during February to April 2006. The reindeer, 94 calves and 21 older reindeer (two adult females, two adult males and 17 male yearlings), were taken from pasture and transported about 100 km to the feeding site, adjacent to a reindeer abattoir. All reindeer were weighed upon arrival and 10 randomly selected calves were slaughtered. The remaining reindeer were separated into calves and older animals and put in outdoor corrals were they were fed reindeer pellets ("Renfoder Standard" from AB Västerbottens Fodercentral, Umeå, Sweden). The average feed consumption was 3.59 kg dry matter (DM) per reindeer and day for the older reindeer. The calves consumed, on average, 1.29, 1.56 and 1.07 kg DM per reindeer and day during day 1-41, 42-53 and 54-60, respectively. The calves were given additional lichens (less than 10 g DM per reindeer and day) during the first weeks of feeding.

The calves were given temperate water whilst the older reindeer had continuous access to fresh snow throughout the feeding period. The weather was mostly clear and sunny with only little precipitation (snow). The temperature varied between +2 °C and -15 °C during the first three weeks. The forth week was colder with night temperatures between -20 °C and -30 °C. Thereafter the weather became milder again.

After 41 days, all reindeer were weighed and 28 randomly selected calves and all the older animals were slaughtered. After 12 more days, the remaining calves were weighed and 27 were slaughtered. One week later, the remaining calves were slaughtered (two calves had died). Notes were made at weighing on whether or not the animals had diarrhoea. Carcass weight, sex and grading (fat and conformation according to the EUROP system transformed to a numerical scale, SJVFS 2004:88) were registered at slaughter. Back length (from the front of the second spinious process of the thoractic vertebræ to the base of the tail) and length of radius (measured from olecranon tuber to the lower gliding joint in carpus) were measured on the hanging carcass. Meat pH was measured in three muscles (*Mm. triceps brachii, longissimus* and *biceps femoris*) one day post slaughter (at slaughter after 53 days no measurement of pH was made).

Live weights were adjusted according to the average relative carcass weight (carcass weight divided by live body mass of the slaughtered animals) at each weighing occasion, respectively, to compensate for possible systematic differences in amount of stomach content. pH values were recalculated to H+-concentrations before statistical analyses. Differences in carcass weight, grading scores, size and pH between slaughter occasions were tested for calves using a linear model with slaughter occasion and sex as fixed effects. Differences in live weight change of calves during the experiment were tested using a linear model with feeding period (41, 53 or 60 days), sex and extent of diarrhoea (no, mild or severe diarrhoea) as fixed effects. The correlation between carcass weight and weight change, respectively, and other variables measured at slaughter were tested using a linear model with slaughter

occasion and sex as fixed effects. The level of significance was set at $P<0.05$. For older animals no statistical analyses were made since they were all slaughtered at one occasion.

Results

The older reindeer began to eat well from the start of the experiment, whilst it took at least one week for the calves to start eating properly. After ten days, some of the calves got diarrhoea and, after one more week, almost all calves were more or less affected. Four of the older animals got diarrhoea. The problem gradually declined, but several calves still had some diarrhoea at the end of the experiment. Two calves died during the experiment, one after 29 days and the other after 45 days.

Both calves and adults gained body mass during the experiment (Fig. 1). The total average weight gain until day 41 (when the older reindeer and the first group of fed calves were slaughtered) was 3.6 kg for calves and 6.0 kg for older reindeer. The variation in weight gain between animals was however large and some calves even lost body mass during this period. The calves that were fed until day 53 and 60, respectively, continued to gain weight at the same average rate as previously. Weight gain was not significantly affected whether the animal had diarrhoea or not. Male calves gained more body mass per day (average of 118 g per day) than female calves (73 g per day).

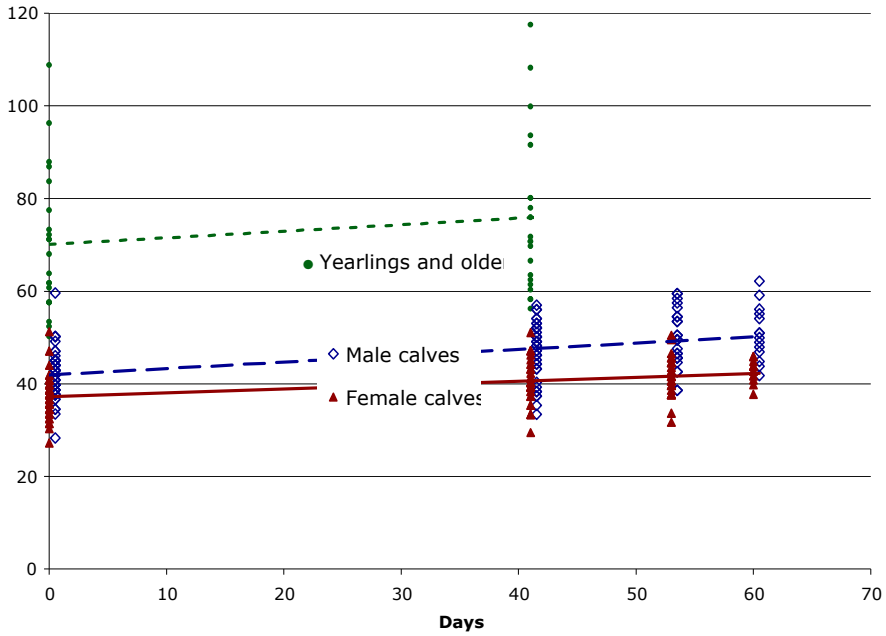

Fig. 1. Live body mass change for the different categories of reindeer during the experiment (body mass is recalculated according to the average relative carcass weight at each weighing occasion, respectively, to compensate for possible systematic differences in the amount of stomach content).

The average carcass weights for calves increased during the experiment (Table 1), as did back length and the length of radius. The carcass weight for male calves was on average 4.0 kg higher than for female calves. Back length and radius length were 2.6 and 1.2 cm longer for male than for female calves. The grading scores for body conformation improved significantly from slaughter I until slaughter III. Muscle pH also improved (decreased) significantly during feeding, indicating a better nutritional status and increased muscle glycogen stores. At the first slaughter, before feeding, pH in *M. triceps branchii* was over 6.2 (the limit for the quality defect DFD) in six of the ten slaughtered calves. In the other two muscles pH was at acceptable levels and only three calves had pH values above 5.8, which is used as a general upper limit for normal pH in meat (Wiklund, 1996). After 41 days (slaughter I), pH had decreased in all the measured muscles. The pH levels declined further until the last slaughter, when the highest value in *M. triceps branchii* was 6.0. The sex of the calf did not significantly affect pH or grading scores.

Size (back length and length of radius) was positively correlated to carcass weight also within slaughter occasion. pH was positively affected (lower values) by higher carcass weight. There was no effect of carcass weight on the conformation and fat grading scores.

Table 1. Results of registrations at slaughter for reindeer calves fed during different periods of time (Least Square Means).

	Slaughter 0	Slaughter I	Slaughter II	Slaughter III
Days of feeding	0	41	53	60
Number of slaughtered calves	10	28	27	29
Carcass weight (kg)	19.1^{a}	22.1^{b}	23.5^{bc}	24.4^{c}
Conformation	4.6^{ab}	4.5^{a}	4.8^{ab}	5.0^{b}
Fat	2.3^{a}	2.8^{b}	2.7^{ab}	2.8^{ab}
Back length (cm)	57.6^{a}	58.7^{ab}	59.5^{b}	61.7^{c}
Radius length (cm)	27.0^{a}	28.4^{b}	29.0^{c}	28.9^{bc}
pH *M. triceps branchii*	6.27^{a}	5.84^{b}	-	5.78^{c}
pH *M. longissimus*	5.61^{a}	5.52^{b}	-	5.47^{c}
pH *M. biceps femoris*	5.69^{a}	5.53^{b}	-	5.47^{c}

Means on the same row with the same letter are not significantly different (P<0,05).

Discussion

Calves that were slaughtered at the start of feeding had carcass weights and grading scores on a normal level for the reindeer herding district (the average calf weight during December to February, according to statistics from the Swedish Board of Agriculture, has been 19.5 kg during the last 5-year period). For older reindeer no comparable statistics are available.

Both older reindeer and calves gained live body mass in spite of the problems with diarrhoea. The weight gain for calves was on the same level or slightly lower than earlier observed in reindeer calves fed pellets during winter (*e.g.* Jacobsen *et al*., 1977; Åhman, 1996; Nilsson *et al*., 2000). Body mass continued to increase during the last part of the experiment, even though the feed consumption was lower compared to earlier. Warmer weather could possibly explain some reduction in feed consumption. A known observation from reindeer herders is that reindeer become less active and spend more time lying and resting during late winter when the days become longer and warmer. At the same time their appetite seems to decline.

The calves not only gained body mass, they also showed some growth of the skeleton during the experiment. Both back and radius increased in length and there seemed to be only little accumulation of fat or muscles according to the classifications. Since the older animals were slaughtered all at one occasion there is no data to show whether or not there was any actual growth also in yearlings.

Meat pH depends on the amount of glycogen (energy) in the muscles at slaughter. After death, the glycogen is metabolised to lactic acid, which reduces pH in the muscle. According to the measured pH values, the energy reserves had increased during feeding and resulted in improved meat quality. Good access to nutrients has a positive effect on meat pH, whilst stress and exertion have negative effects (Wiklund, 1996). In the present experiment, lower pH with time might be a combination of the improved nutrition and the reindeer gradually becoming tamer and therefore less susceptible to stress at handling. However, the larger calves and those that had gained a lot of weight, *i.e.* those that had improved their nutritional condition most, had generally higher pH than other calves slaughtered at the same occasion. This indicates that the improvement of pH was mostly an effect of improved nutritional status as previously demonstrated for reindeer (Wiklund *et al.*, 1996).

The body mass gain varied substantially between animals. The most important factor was probably how fast the animals started to eat pellets. Even if we did not observe any effect of diarrhoea on weight gain, the diarrhoea show that the digestion was to some extent disturbed. This may have influenced negatively the ability of the reindeer to utilize the feed nutrients.

The growth means increase of skeleton size, that we observed during the experiment was not expected, since it is often claimed that reindeer do not grow during winter (e.g. Rehbinder & Nikander, 1999). The experiment shows that there is a potential for growth in reindeer calves, even during winter, if the access to energy and nutrients is good enough.

Given the preconditions present in this experiment, it was possible to get a significant weight gain and skeleton growth in reindeer during six weeks of feeding. Additional feeding resulted in better weight and quality of the slaughtered reindeer. The feed consumption was however high in relation to the weight gain (2.7 and 4.7 kg pellets per 100 g increase in carcass weight for calves and older reindeer, respectively). It is therefore doubtful if the improvement of carcass weight and quality alone can motivate the costs for feeding.

It is however concluded that, if reindeer have to be fed before slaughter for some reason (e.g. radiaoactive contamination), six weeks could be regarded as a minimum of time in order to obtain good carcass weights and good meat quality, and that one or two additional weeks can be recommended.

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Tillväxt och viktutveckling hos vinterutfodrade renar

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Artikel:

Introduktion
Varje vinter utfodras några tusen renar i Sverige för att sänka halterna av radioaktivt cesium i köttet före slakt (Åhman, 2005). Renägarna ersätts av staten för kostnader i samband med denna utfodring. Detta projekt genomfördes på uppdrag av Statens jordbruksverk för att förbättra underlaget för beslut om ersättningsbelopp för utfodring. Försöket, där renar utfodrades med fullfoder (pellets) under två månader på senvintern, visade att vikt, och kroppsstorlek generellt ökade under utfodringen, men att det krävdes mer än sex veckors utfodring för att alla renar skulle uppnå den vikt de hade vid utfodringens start.

Material och metoder
Försöket utfördes i norra Sverige under februari-april 2006. Renarna, 94 kalvar och 21 äldre djur (två vajor, två äldre tjurar och resten 2-åriga handjur), togs från bete och transporterades med bil ca 100 km till utfodringsplatsen, som låg i anslutning till ett renslakteri. Vid ankomsten vägdes djuren och 10 slumpvis utvalda kalvar slaktades. Övriga renar delades upp på kalvar och äldre djur och sattes i hagar utomhus där de utfodrades med pelleterat renfoder (”Renfoder standard” från AB Västerbottens fodercentral, Umeå). De äldre renarna åt i genomsnitt 3,59 kg TS per ren och dag, medan kalvarna förbrukade 1,29, 1,56 och 1,07 kg TS per ren och dag under dag 1-41, 42-53 respektive 54-60. Under de första veckorna fick kalvarna dessutom lite renlav (mindre än 10 g TS per ren och dag).
Kalvarna hade tillgång till tempererat vatten medan de äldre renarna hade kontinuerlig tillgång till ren snö. Vädret under försöket var mestadels klart med bara lite nederbörd i form av snö. Temperaturerna varierade från någon plusgrad ner till -15 °C under de första tre veckorna. Fjärde veckan var kallare, med nattemperaturer på -20 °C till -30 °C. Därefter blev det mildare igen.
Efter 41 dagar vägdes alla renar och 28 slumpvis utvalda kalvar och samtliga äldre renar slaktades. Efter ytterligare 12 dagar vägdes de kalvar som var kvar och 27 slaktades, och efter en vecka till vägdes och slaktades de återstående 29 kalvarna (2 kalvar hade dött under försöket). Uppgifter om eventuell diarré noterades vid vägning. Vid slakt registrerades slaktvikt, kön och klassning (form och fett enligt EUROP-systemet transformerat till en sifferskala, SJVFS 2004:88). Storleken på slaktkroppen mättes som rygglängd (från framkanten på andra ryggkotan till bakkanten på sista ländkotan) och längd på underbenet fram, radius/ulna, (från nedre ledytan till armbågsspetsen). Mätning av pH i bog, rygg (ytterfilé) och stek (ytterlår) gjordes dagen efter slakt, med undantag av slakten efter 53 dagar.
Levande vikter justerades med hänsyn till slaktutbyte vid det aktuella vägningstillfället för att kompensera för eventuella systematiska olikheter i mängden mag-tarminnehåll. pH-värden räknades om till vätejonkoncentration före statistisk analys. Skillnader mellan de olika slakttillfällena i kalvarnas slaktvikt, klassning, storlek och pH testades i en linjär modell med slakttillfälle och kön som fixa effekter. Skillnader i förändring av levande vikt hos kalvar under försöket testades med en linjär modell med utfodringsperiod, kön och grad av diarré (ingen, mild respektive kraftig diarré) som fixa effekter. Sambandet mellan slaktvikt respektive viktförändring under försöket och övriga variabler uppmätta vid slakt testades i en linjär modell med slakttillfälle och kön som fixa effekter. Signifikansnivån sattes till $P<0,05$. För äldre djur gjordes inga statistiska analyser eftersom alla slaktades vid ett och samma tillfälle.

Resultat
De äldre renarna började äta bra i stort sett från försökets start medan det tog en dryg vecka innan kalvarna hade börjat äta ordentligt. Efter 10 dagar fick några kalvar diarré. Detta spred sig sedan och de flesta kalvar hade mer eller mindre diarré efter ytterligare en vecka. Fyra av de äldre renarna hade

diarré. Diarréerna minskade så småningom, men flera kalvar hade fortfarande lite diarré när försöket avslutades. Två kalvar dog under försöket, en efter 29 dagar och den andra efter 45 dagar.
Både kalvar och äldre renarna ökade generellt i vikt under försöket (Fig. 1). Den totala viktökning fram till dag 41 (då de äldre renarna och den första gruppen utfodrade kalvar slaktades) var i genomsnitt 3,6 kg för kalvar och 6,0 kg för äldre renar. Skillnaderna mellan individer var dock stor och några av kalvarna förlorade vikt under samma period. De kalvar som utfodrades 53 respektive 60 dagar fortsatte att öka i vikt i samma genomsnittliga takt som tidigare. Renarnas viktutveckling påverkades inte signifikant av om renen hade diarré eller inte. Hankalvarna ökade snabbare i vikt (118 gram per dag i genomsnitt) än honkalvarna (73 gram/dag).

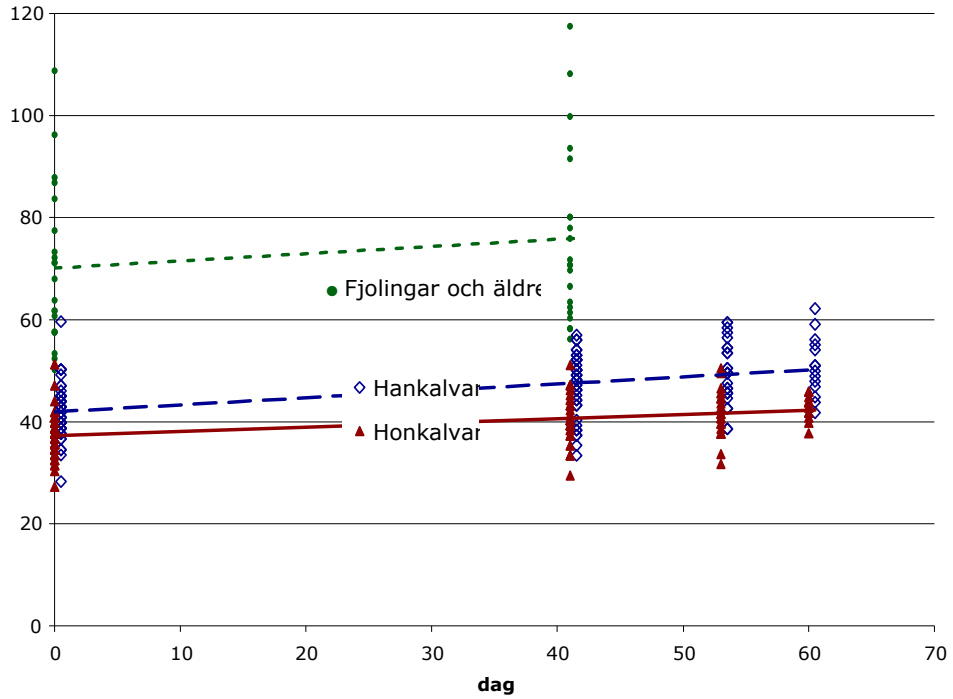

Fig. 1. Förändring av levande vikt under försöket i olika kategorier av renar (vikten är korrigerad med hänsyn till slaktutbyte vid de olika tidpunkterna för att kompensera för eventuella olikheter i magfyllnad).

De genomsnittliga slakvikterna för kalvarna ökade under försöket (Tabell 1), liksom även rygglängd och längd på frambenet (radius). Slaktvikterna för tjurkalvar var 4,0 kg högre än för vajkalvar. Rygg och radius var 2,6 respektive 1,2 cm längre för tjurkalv än för vajkalv. Formklass förbättrades från slakt I (41 dagars utfodring) till slakt III (60 dagar). Musklernas pH förbättrades (sjönk) också signifikant under utfodringen, vilket är ett tecken på bättre näringsmässig status och högre glykogenreserver i muskulaturen. Vid slakt 0, före utfodring, hade 6 av de 10 slaktade kalvarna pH-värden över 6,2 (gräns för kvalitetsfelet DFD) i bog, medan pH i ytterfilé och ytterlår låg på acceptabla nivåer och endast i tre fall över 5,8, vilket generellt används som övre gräns för ett normalt pH (Wiklund 1996). Vid slakt I, efter 41 dagars utfodring, hade pH-värdena i samtliga undersökta muskler sjunkit signifikant. Till slakt III, efter 60 dagar, hade de sjunkit ytterligare och högsta pH-värdet i bog låg då på 6,0. Kalvens kön påverkade inte pH och klassning.
Storlek (rygglängd och längd på radius) var positivt korrelerad till slaktvikt, även inom slakttillfälle. Också pH påverkades positivt (lägre värden) av högre slaktvikt, däremot påverkades inte klassningen signifikant.

Tabell 1. Slaktresultat för renkalvar utfodrade under olika lång tid (Least Square Means).

	Slakt 0	Slakt I	Slakt II	Slakt III
Dagar utfodring	0	41	53	60
Antal slaktade kalvar	10	28	27	29
Slaktvikt (kg)	19,1[a]	22,1[b]	23,5[bc]	24,4[c]
Formklass	4,6[ab]	4,5[a]	4,8[ab]	5,0[b]
Fettklass	2,3[a]	2,8[b]	2,7[ab]	2,8[ab]
Rygglängd (cm)	57,6[a]	58,7[ab]	59,5[b]	61,7[c]
Radiuslängd (cm)	27,0[a]	28,4[b]	29,0[c]	28,9[bc]
pH bog	6,27[a]	5,84[b]	-	5,78[c]
pH ytterfilé	5,61[a]	5,52[b]	-	5,47[c]
pH ytterlår	5,69[a]	5,53[b]	-	5,47[c]

Medelvärden på samma rad med samma bokstav är inte signifikant skilda (P<0,05).

Diskussion

De renkalvar som slaktades i samband med utfodringens start hade slaktvikter och klassning som låg på normal nivå för samebyn (enligt statistik från Jordbruksverket har den genomsnittliga slaktvikten för kalvar på vintern, december till februari, legat på 19,7 kg under den senaste 5-årsperioden). För äldre renar har vi inte motsvarande jämförelsevärden.

Renarna, både kalvar och äldre, ökade generellt i vikt trots problem med diarréer. Viktökningen för kalvar var på ungefär samma eller något lägre nivå än den man tidigare sett för renkalvar i försök då man utfodrat med pelleterat foder på vintern (ex. Jacobsen m.fl., 1977; Åhman, 1996; Nilsson m.fl., 2000). Trots att kalvarnas foderkonsumtion sjönk mot slutet av försöket fortsatte vikterna att öka. Mildare väder kan möjligen förklara en viss nedgång i foderkonsumtion. En vanlig observation bland renägare är, att renen blir mindre aktiv och mest ligger och vilar på vårvintern när dagarna blir längre och varmare. Samtidigt tycks aptiten sjunka.

Kalvarna ökade inte bara i vikt utan visade även en tillväxt av skelettet under försöket. Både rygglängd och benlängd ökade, medan viktökningen inte resulterade i någon märkbar ansättningen av muskler och fett, enligt resultaten av klassningen. Eftersom samtliga äldre renar slaktades samtidigt, är det okänt om det förekom någon skellettillväxt bland dessa djur.

Köttets pH är beroende av glykogenreserverna (dvs energin) i musklerna vid slakt. Glykogen bryts ner till mjölksyra och sänker köttets pH. Att döma av pH-värdena hade energireserverna i musklerna ökat som ett resultat av utfodringen, vilket resulterat i en förbättring av köttets kvalitet. God näringstillgång påverkar i allmänhet köttets pH positivt, medan stress och ansträngning har negativa effekter (Wiklund, 1996). I detta försök skulle förbättringen (sänkningen) av pH-värdena under utfodringen kunna vara en kombination av god näringstillgång och att renarna blivit tamare, och därmed mindre benägna att bli stressade vid hantering. De större kalvarna och de som ökat mycket i vikt, det vill säga de som hade förbättrat sin kondition mycket, hade dock generellt lägre pH-värden än övriga som slaktades vid samma slakttillfälle. Detta tyder på att förbättringen av pH i köttet till stor del var ett resultat av förbättrad kondition hos djuren vilket tidigare visats för ren (Wiklund m.fl., 1996).

Viktutvecklingen under försöket skilde avsevärt mellan olika individer. Den viktigaste faktorn är troligen att renarna kom igång att äta olika fort. Även om vi inte kunde se att diarré hos enskilda renar gjorde någon skillnad på viktökning, visar diarrérna att renarnas fodersmältning i viss mån var störd. Detta kan ha haft negativ påverkan på renarnas förmåga att tillgodogöra sig näringsämnena i fodret.

Den tillväxt, dvs ökning av skelettstorlek, som vi observerade under försöket var i viss mån oväntad eftersom det ofta framhålls att renar inte växer under vintern (ex. Rehbinder & Nikander, 1999).

Försöket visar att det finns en tillväxtpotential hos renkalvar även under vintern om bara näringstillgången är tillräcklig.
Resultaten visar att, med de förutsättningar som gällde i detta försök, hinner man få en betydande ökning av slaktvikterna på sex veckors utfodring. Ytterligare några veckor resulterar i ännu bättre vikt och kvalitet på renslaktkropparna. Foderåtgången är emellertid hög i relation till viktökningen (2,6 och 4,7 kg konsumerat foder per 100 gram ökad slaktvikt för kalv respektive äldre ren) och det är tveksamt om enbart förbättringen i slaktvikt och kvalitet kan motivera kostnaderna för utfodringen.
Slutsatsen av försöket blir dock att, om renar någon anledning (exempelvis radioaktiv förorening) måste utfodras före slakt, kan sex veckor anses som en kortaste utfodringstid för att få bra slaktvikter och god köttkvalitet, och att ytterligare en till två veckor kan rekommenderas.

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The effects of wintertime undernutrition on blood leptin, insulin and some protein metabolites of reindeer calves

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The regulation of feed intake, body weight and body fat in animals is poorly known. The animals that have seasonal cycles in body weight, such as the reindeer, decrease their feed intake voluntarily during winter even if they have free access to high-quality feed. It has been suggested that the effect of a short day-length mediated by hormones such as an insulin or insulin-like growth factor is involved in the regulation of seasonal feed intake and body weight in reindeer. Leptin which is a protein secreted by white fat/adipose tissue, is now known to play an important role in the control of feed intake and body weight cycles in mammals. Studies in seasonal species have shown that plasma leptin is modified by the photoperiod, and that low leptin plays a role in the saving of energy during the long periods of food deprivation during winter.
The aim of this study was to identify the effects of different feeding levels on plasma leptin and insulin and a few protein metabolites (total proteins, albumin, urea and creatinine) in reindeer fed either their preferred winter feed, low-protein lichen (3% crude protein in dry matter), or high-protein reindeer pellets (10% crude protein in dry matter) during winter and spring (from January to June). The reindeer (male <1 year) were fed their lichen *ad libitum* for 5 weeks, followed by 40% restriction of energy for 8 weeks and thereafter re-feeding with high-protein pellets for 6 weeks. The control group received high-protein reindeer pellets *ad libitum* throughout the experiment. The animals were exposed to natural changes in seasonal ambient temperature (daily Ta varied from -18.4 to +7.8 °C) and photoperiod (2 h light: 22 h dark in January, and 24 h light in June) during the study. Plasma leptin decreased by 46% and insulin by 54% in the lichen group already during the *ad libitum* period between January and February, with parallel decreases in body weight, serum total proteins, albumin and urea. Leptin remained low during most of the energy restriction period in March and April, while body weight decreased. However, at the end of April leptin increased while insulin decreased. During the re-feeding period in May and June, the body weight and insulin of the lichen group increased in parallel with total proteins and urea but leptin remained unchanged. Similar significant reductions in plasma leptin (40%) as in the lichen group in January and February also took place in the control group fed high-protein pellets *ad libitum*, although their feed intake, serum total proteins and body weight remained unchanged. The results show that leptin decreases in reindeer during mid-winter, independent of food or protein intake, and suggest that the leptin may be down-regulated by seasonal factors such as the short light period. Low level of leptin in turn may down-regulate energy expenditure and inhibit body weight increase. Serum protein metabolites reflect low protein intake and possible use of tissue proteins in the reindeer fed lichen.

Publication

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Talviaikaisen aliravitsemuksen vaikutukset poronvasojen veren leptiini- ja insuliinitasoihin sekä eräisiin proteiini-metaboliitteihin

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Eläinten ravinnonoton, ruumiinpainon ja rasvakudoksen määrän säätely tunnetaan vielä huonosti. Niillä eläimillä, joiden paino seuraa vuodenaikojen vaihteluja, ravinnonotto vähenee talvella silloinkin kun hyvälaatuista ravintoa on vapaasti saatavilla. Lyhyen päivänpituuden uskotaan liittyvän ravinnonoton ja ruumiinpainon vuodenaikaiseen säätelyyn hormonien, kuten insuliinin tai insuliininkaltaisen tekijän välityksellä. Viimeaikaiset tutkimukset ovat osoittaneet, että rasvakudoksen erittämä leptiini-hormoni näyttelee tärkeää osaa nisäkkäiden ravinnonoton ja ruumiinpainon säätelyssä. Tutkimukset vuodenaikaisilla lajeilla ovat osoittaneet, että valojakso vaikuttaa leptiinin eritykseen ja alhainen leptiinitaso on yhteydessä energian säästämiseen pitkien ravinnonpuutosjaksojen aikana talvella.
Tämän tutkimuksen tarkoituksena oli määrittää erilaisten ruokintatasojen vaikutusta poron veren leptiini – ja insuliinitasoihin sekä eräisiin proteiinimetaboliitteihin (kokonaisproteiinit, albumiini, urea ja kreatiniini). Poroja ruokittiin joko vähän valkuaista sisältävällä jäkälällä (3% raakavalkuaista kuiva-aineessa), tai paljon valkuaista sisältävillä rehupelleteillä (10% raakavalkuaista kuiva-aineessa) tammikuusta kesäkuun alkuun. Porot olivat alle vuoden ikäisiä urosvasoja, joita ruokittiin jäkälällä rajoituksetta eli *ad libitum* 5 viikon ajan, jonka jälkeen jäkälänannon energiatasoa rajoitettiin 40 % 8 viikon ajan. Kuntoutusjakson aikana eläimiä ruokittiin paljon valkuaista sisältävillä pelleteillä 6 viikkoa. Vertailuryhmä sai 10% valkuaista sisältäviä pellettejä *ad libitum* koko kokeen ajan. Porot olivat alttiina luontaisille ulkolämpötilan (päivän keskilämpötila -18.4 - +7.8 °C) ja valojakson vaihteluille (2 h valoa: 22 h pimeää tammikuussa ja 24 h valoa kesäkuussa) tutkimuksen aikana. Plasman leptiini laski jäkäläryhmällä 46% ja insuliini 54% jo *ad libitum*-ruokinnan aikana tammi-helmikuussa samalla kun porojen painot, seerumin kokonaisproteiinit, albumiini ja urea laskivat. Leptiini pysyi alhaisena suurimman osan energian rajoitusjaksoa maalis-huhtikuussa samalla kun painot laskivat. Leptiini kuitenkin nousi huhtikuun lopussa insuliini laskiessa. Kuntoutusjakson aikana touko-kesäkuussa jäkäläryhmän paino ja insuliini lisääntyivät samanaikaisesti kokonaisproteiinien ja urean kanssa mutta leptiinissä ei ollut muutoksia. Vertailuryhmällä, jota ruokittiin paljon valkuaista sisältävillä pelleteillä, leptiini laski tammi-helmikuussa samalla tavalla merkitsevästi (40%) kuin jäkäläryhmällä, vaikka vertailuryhmän ravinnonotto, seerumin kokonaisproteiinit ja painot pysyivät muuttumattomina. Tulokset osoittavat, että leptiinitasot laskevat porolla keskitalvella riippumatta ravinnon ja valkuaisen saannista ja viittavat siihen, että vuodenaikaiset tekijät kuten lyhyt valojakso voi säädellä leptiiniä. Alhainen leptiinitaso voi vuorostaan vähentää energiankulutusta ja estää painon nousun. Seerumin proteiinimetaboliittien muutokset heijastavat valkuaisen saantia ravinnosta ja jäkäläryhmällä mahdollisesti myös kudosproteiinien hajotusta.

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Lichen height as a range management tool

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In reindeer husbandry it is important to avoid overuse of lichen resources. The lichen is a slow-growing perennial resource and changes are difficult to monitor. A previous study showed that lichen height can be used to estimate lichen biomass. In this study we investigated how lichen height measurements should practically be designed in order to get enough power to detect changes in lichen cover. We measured lichen height in transects on a small (30 m) and a large scale, several transects (100 m) within the same area. The areas where chosen to have a mosaic age structure of forest stands. We also repeatedly measured lichen height at the same spot at different levels of lichen humidity. Preliminary results showed that lichen height measures were auto-correlated for up to 5 m, but on a larger scale no auto-correlation was found except when lichen cover were fragmented with spots of pure grass or shrubs, or by stones. Lichen height was influenced by forest stand age as well as forest density and lichen humidity. Preliminary power analysis showed that about 170 points have to be measured to detect a change in lichen height of 1 cm with power 0.9 and 675 points are needed to detect changes of 0.5 cm with the same power. The strategy for use of lichen height is a trade-off between the needs of frequent detections of changes and trends (early warnings) and the effort spent on measuring. The longer time interval between measurements, the fewer points has to be measured for detecting changes.

Lavhöjd som ett verktyg vid betesmarksförvaltning

I renskötseln är det viktigt att undvika överutnyttjande av lavbetesresurserna. Laven är en långsamtväxande flerårig resurs och förändringar i denna är svårt att övervaka. En tidigare studie visade att lavhöjd kan användas för att skatta lavbiomassa. I denna studie har vi undersökt hur lavhöjdmätningar praktiskt bör utformas så att noggrannheten är tillräcklig för att kunna upptäcka förändringar i lavtäcket. Vi mätte lavhöjd i transekter på en liten skala (30 m långa) och på en stor skala, flera transekter (100 m långa) inom samma område. Områdena valdes så att där var mosaik i åldern på bestånden. Vi gjorde också upprepade mätningar vid olika grader av fuktighet i laven. Preliminära resultat visar att lavhöjdmätningarna var autokorrelerade upp till 5 m, men på större skalor fanns ingen autokorrelation bortsett från områden där lavtäcket var fragmenterat av rena gräs- eller risfläckar, eller stenar. Lavhöjden var beroende av skogens ålder och täthet samt lavens fuktighet. Preliminära poweranalyser visade att runt 170 mätpunkter krävs för att upptäcka en skillnad på 1 cm i lavtäcket med power 0,9 och runt 675 mätpunkter krävs för att upptäcka en skillnad på 0,5 cm med samma power. Strategin för att användning av lavhöjd blir därmed en avvägning mellan behovet av täta mätningar, som ger tidig information om förändringar och trender, och resurserna som krävs för mätningen. Ju längre intervallet är mellan mätningarna, desto färre punkter behöver mätas för att förändringar ska upptäckas.

Animal age but not gender affected the tenderness and colour of reindeer meat

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The effects of animal age and gender on tenderness and colour of *M. longissimus* samples were assessed for reindeer (*Rangifer tarandus tarandus)* that were either adult (10 males and 10 females, all > 1.5 yr) or calves (5 males and 5 females, all 6-mo-old). All animals were traditionally raised under extensive conditions in northern Norway, Finnmark.
Meat samples were aged for 7 days at 2-3 °C before being frozen. Calf samples were more tender in terms of WB shear values for samples cooked in a water bath for 90 min at either 60 °C (1.33 *vs* 4.58 kg; $P < 0.0001$) or 70 °C (2.40 *vs* 7.19 kg; $P < 0.0001$). The greater tenderness was not associated with any significant age effects on sarcomere length (1.38 *vs* 1.33 µm; $P = 0.42$), ultimate pH (5.57 *vs* 5.62; $P = 0.92$), or cooking losses, but the calf samples did have a slightly higher average myofibrillar fragmentation index (97.0 *vs* 95.6; $P = 0.011$). Samples from all groups were characterised by having very low shear values, which may be attributable in part to the very short average sarcomere lengths. Such short sarcomeres suggest that the thick myosin filaments may have penetrated and disrupted the Z-disk structure, thereby causing an increase in tenderness. There were no significant differences between samples from males and females for shear force values, and no significant interactions between gender and animal age.
Measures of meat colour by a Minolta Chromameter to give L*, a* and b* values showed that, relative to meat from the adult reindeer, meat from reindeer calves had a lighter colour (L* = 36.2 *vs* 34.5; $P = 0.009$), a redder colour (a* = 7.9 *vs* 6.8; $P = 0.001$), and a slightly higher b* value (-0.44 *vs* -1.44; $P = 0.002$). The negative average b* values were unexpected and are difficult to interpret in colour terms. The difference between percentage reflectance at 630 nm and 580 nm was higher for the calf samples (1.80 *vs* 1.36; $P < 0.001$), which suggests that they had formed less metmyoglobin at the time of measurement. The significant effect of age on reindeer meat colour reported here was not associated with any significant age effects on haem iron content, or on levels of intramuscular fat, although that was slightly higher for the calf group (0.94 *vs* 0.74%; $P = 0.40$), and there was a trend for non-haem iron levels to be lower in the calf samples (0.62 *vs* 0.79 mg/100g; $P = 0.07$). None of the meat colour parameters differed significantly between samples from the male and female groups, and there were no significant interactions between gender and animal age.
It is concluded that with an increase in age from six months to adult, a decrease in the tenderness of reindeer meat can be expected along with a darkening of the colour of that meat, although even from adults the meat was very tender, and even from the calves it was quite dark. With regard to the gender effect, it should be noted that the adult females were older on average (5 to 10 years *vs* >1.5 years), which means that it is possible that a gender effect was masked to some extent by an age effect in the opposite direction.

Dyrets alder, men ikke kjønn påvirket mørheten og fargen i reinkjøtt

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Det ble undersøkt om effekten av alder og kjønn påvirket mørhet og farge i *M. longissimus* i reinsdyr (*Rangifer tarandus tarandus)* som var enten voksne (10 hannkjønn og 10 hunnkjønn, alle > 1.5 år) eller kalver (5 hannkjønn og 5 hunnkjønn alle 6-måneder gamle). Alle dyrene var fra tradisjonell reindrift i Nord Norge, Finnmark.
Kjøttprøvene ble mørnet i 7 dager ved 2-3 °C før de ble frosset. Kalvekjøtt prøvene var mørest i verdier. WB skjærekraft for prøver som var kokt i vannbad i 90 min ved enten 60 °C (1.33 *vs* 4.58 kg; $P < 0.0001$) eller 70 °C (2.40 *vs* 7.19 kg; $P < 0.0001$). Den økte mørheten hadde ikke sammenheng med alderseffekten på sarkomer-lengden (1.38 *vs* 1.33 µm; $P = 0.42$), slutt pH (5.57 *vs* 5.62; $P = 0.92$) eller koketap. Kalveprøvene hadde noe høyere gjennomsnitts myofibrillar fragmentation index (97.0 *vs* 95.6; $P = 0.011$). Prøvene fra alle grupper kunne sies hadde lav skjærekraft, som kan være på grunn av de korte gjennomsnitts sarkomere lengden. Slike korte sarkomer lengder kan ha en sammenheng med at den tykke myosin filamenten kan ha gjennomboret og forstyrret Z-disk strukturen, og dermed kan ha økt mørheten. Det var ingen signifikant forskjell mellom prøver fra hunnkjønn og hannkjønn i skjærekraft verdier, og heller ingen signifikant samspill mellom kjønn og alder på dyret.
Målinger av kjøttfarge med Minolta Chromameter som gir L*, a* og b* verdier, viste at kjøtt fra voksne reinsdyr, relativt til kjøtt fra reinsdyrkalver hadde en lysere farge (L* = 36.2 *vs* 34.5; $P = 0.009$), var rødere (a* = 7.9 *vs* 6.8; $P = 0.001$) og hadde en noe høyere b* verdi (-0.44 *vs* -1.44; $P = 0.002$). De negative gjennomsnitts b* verdiene var ikke forventet og den er vanskelige å forklare da det ikke observeres ofte på kjøttdyr. Forskjellen mellom prosent refleksjonen ved 630 nm og 580 nm var høyere for kalveprøvene (1.80 *vs* 1.36; $P < 0.001$), som dermed foreslås å danne mindre met-myoglobin ved måletidspunktet. Den signifikante alderseffekten på kjøttfargen som rapportert her hadde ikke sammenheng med noen signifikant alders effekt av heme jern innhold, og heller ikke i av nivået av intramusklært fett selvom der var noe høyere i kalvegruppen (0.94 *vs* 0.74%; $P = 0.40$). Det var en trend at ikke-heme jern nivåer var lavere i kalveprøvene (0.62 *vs* 0.79 mg/100g; $P = 0.07$). Det var ingen forskjell i noen av kjøttfarge parametere mellom prøver fra hunnkjønn og hannkjønn gruppene, og det var heller ingen signifikant interaksjon/samspill mellom kjønn og dyrets alder.
Det ble konkludert med at en økning i alder fra seks måneder til voksne dyr, medfører at mørheten i reinsdyr minke, sammen med at kjøttfargen blir mørkere. Kjøtt fra voksne reinsdyr kan likevel være mørt, og kjøtt fra kalver kan være ganske mørke i fargen Angående kjønnseffekten, så bør det legges merke til at voksne hunnkjønn hadde høyere gjennomsnitts alder (5 til 10 år *vs* >1.5 år), som igjen betyr at det kan være mulig at kjønnseffekten ble skjult av alderseffekten i motsatt retning.

Consumer evaluation of three meat products made from utility and premium grade reindeer meat

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Premium cuts of inspected reindeer meat (steaks and roasts) can readily be marketed in retail outlets and restaurants. However, over 60% of the meat produced from a carcass is of utility grade. Value-added processing of this meat can be used to expand market potential. Many different methods of processing and preparation of utility meat are typically used to produce a desirable end product, with slicing, grinding and cubing being the most commonly used methods to improve value and increase marketability. The American consumers, processors, retailers and restaurants need to be educated on the unique characteristics of reindeer meat. The goal of this study was to compare two new processed reindeer meat products and compare their acceptability with the traditional Alaskan reindeer stew.
A total of 8 reindeer steers (ages 3 to 6 years old) from the AFES Reindeer Research Program herd (University of Alaska Fairbanks; UAF) were used in the study. The reindeer were transported to Delta Meat and Sausage (Delta Junction, Alaska) and slaughtered under USDA inspection. Carcasses were de-boned into two partitions: primal cuts (tenderloin, strip loin, and topside) and "secondary" cuts (all other muscle groups). The "secondary" muscle groups were divided into two pooled samples; one sample consisted of the cuts silverside, knuckle, rump and chuck roast (called premium grade) and the other sample included meat from the shanks, neck, ribcage and shoulder (utility grade). The premium and utility grade pooled samples were each further divided into three sub-samples which were processed using commercial equipment to create thin sliced, cubed and ground products. All meat samples were frozen after boning and stored at -20 ^{o}C until processing at the SFOS Fishery Industrial Technology Center in Kodiak, Alaska. The sliced, cubed and ground meat was packaged and re-frozen and transported to the Cooperative Extension Service Research Kitchen (UAF, Fairbanks) where the three products (hamburgers, thin sliced stir fry meat and stew in gravy) were manufactured.
A consumer preference test of the three different products was carried out in connection with the Alaskan Federation of Native's annual convention (October 2006 in Anchorage). 142 consumers participated in the test. The consumers preferred products made from the utility grade meat for the hamburgers and thin sliced product. However, there was no preference shown between the premium and utility grade stew meat products. These results illustrate the importance of processing technique and cooking method for the final eating quality of different meat cuts.

Konsumenttest av tre renköttsprodukter

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Värdefulla styckningsdetaljer från renslaktkroppar som t.ex. ytterfilé, innanlår och andra stekar kan lätt marknadsföras till butiker och restauranger. Men bara 40% av en slaktkropp består av värdefulla styckningsdetaljer och därför är vidareförädling viktigt för att höja värdet på resten av slaktkroppen. Det finns många olika metoder för vidareförädling av kött/styckningsdetaljer, t.ex. skivning, malning och tärning som är några av de vanligaste teknikerna som används. Den amerikanska konsumenten, förädlingsindustrin, detaljister och restauranger måste informeras om de unika egenskaperna hos renkött. Målet med denna studie var att jämföra två förädlade renköttsprodukter med den traditionella tillagningsmetoden för renkött i Alaska (ren-gryta/kalops).
Totalt användes 8 kastrerade renar (härkar, 3 - 6 år) från AFES Reideer Research Programs försöks-hjord (University of Alaska Fairbanks, UAF) i undersökningen. Renarna transporterades till Delta Meat and Sausage (Delta Junction, Alaska) och slaktades enligt normal rutin (under USDA-kontroll). Vid styckningen delades styckningsdetaljerna upp i två grupper: ”värdefulla” styckningsdetaljer (innerfilé, ytterfilé och innanlår) och "mindre värdefulla" styckningsdetaljer (alla andra muskel-grupper). Den "mindre värdefulla" gruppen delades vidare upp i två samlingsprover, ett prov bestod av styckningsdetaljerna ytterlår, fransyska, rostbiff och entrecôte (”hög kvalitet”) i det andra provet ingick kött från lägg, hals, revben/bröstkorg och bog (”lägre kvalitet”). Samlingsproverna ”hög” och ”lägre” kvalitet delades i ytterligare tre undergrupper som användes för kommersiell vidareförädling till renskav, grytbitar och köttfärs. Alla köttprover frystes först efter styckning och lagrades vid -20 °C tills de vidareförädlades vid SFOS Fishery Industrial Technology Center i Kodiak, Alaska. De för-ädlade produkterna (renskav, grytbitar och köttfärs) vakumförpackades och transporterades frysta (-20 °C) till Cooperative Extension Service Research Kitchen (UAF, Fairbanks) där tre produkter tillagades (rengryta/kalops, renskav och hamburgare).
Konsumenttestet av de tre olika produkterna gjordes i samband med Alaskan Federation of Natives årliga sammankomst (oktober 2006 i Anchorage). 142 konsumenter deltog i testet. Konsumenterna föredrog hamburgare och renskav som tillverkats av den ”lägre” kvaliteten på styckningsdetaljer jämfört med hamburgare och renskav tillverkat av den ”högre” kvaliteten. För rengrytan/kalopsen fanns enligt konsumenterna ingen skillnad mellan de olika kvaliteterna på styckningsdetaljer för den slutliga ätkvaliteten. Dessa resultat illustrerar att det är viktigt med rätt val av styckningsdetalj och tillagningsmetod för ätkvaliteten hos olika förädlade produkter.

Deer ked – a threat to reindeer herding?

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The deer ked (*Lipoptena cervi*) is an ectoparasitic louse fly capable of infecting various cervids. It has spread rapidly towards the northern latitudes in Finland during the last four decades. At present, the northern distribution limit of this louse fly is in the southern part of the Finnish reindeer herding area. The deer ked has a great potential to cause hazards for reindeer health. The present experiment investigated if the deer ked can use the reindeer as a host and if medical treatment against this parasite would be available. Twelve reindeer were infected with 300 flies each while another six control animals were not experimentally infected (group I = Infection, group II = Infection and Medication, group III = Control). In groups I and II reindeer scratched themselves leaving bare patches and chafes in the pelt. Reindeer in group II were treated with subcutaneous ivermectin after two months. After five weeks the ivermectin-treated animals had only dead flies while the non-treated animals had live and dead deer keds and a single pupa. The differences in the numbers of live and dead deer keds between the groups I and II were statistically significant because the reindeer of the group II had no live deer keds and number of dead flies in that group was higher than in group I. The results suggest that the deer ked could use reindeer as a host and that ivermectin would be effective against this parasite. More studies are still needed about the right timing of the medication and the efficacy against a high number of deer keds.

Hirvikärpänen – uhka poronhoidolle?

Hirvikärpänen (*Lipoptena cervi*) on täikärpäsiin kuuluva hirvieläinten ektoparasiitti. Suomessa se on levinnyt nopeasti kohti pohjoista ja tällä hetkellä levinneisyysalue yltää poronhoitoalueen etelärajalle. Hirvikärpänen voi olla poroille terveysriski. Tutkimuksessa pyrittiin selvittämään, voiko hirvikärpänen hyödyntää poroa isäntäeläimenä ja voidaanko hirvikärpästä torjua loislääkkeellä. Kokeessa oli 18 poroa, jotka muodostivat kolme ryhmää (ryhmä I = koeryhmä, ryhmä II = lääkitysryhmä, ryhmä III = kontrolliryhmä). Ryhmien I ja II poroihin istutettiin hirvikärpäsiä (300 / poro). Ryhmien I ja II porot rapsuttivat itseään ja karvapeitteissä oli aukkoja ja hankaumia. Kaksi kuukautta myöhemmin ryhmän II poroihin injektoitiin ivermektiini-loislääkettä. Viiden viikon kuluttua hirvikärpäset laskettiin ja ryhmästä I löytyi myös yksi kotelo. Kuolleiden ja elävien hirvikärpästen osalta löytyi tilastollisesti merkitsevä ero, koska ryhmän II poroissa ei ollut eläviä hirvikärpäsiä ja kuolleita hirvikärpäsiä oli enemmän kuin ryhmässä I. Tutkimuksen tulosten perusteella hirvikärpänen voi käyttää poroa isäntä-eläimenä ja ivermektiini-loislääke näyttäisi vaikuttavan hirvikärpäseen. Kuitenkin tarvitaan lisätietoa lääkityksen oikeasta ajankohdasta ja tehokkuudesta korkeampaa hirvikärpäsmäärää vastaan.

Setaria tundra, an emerging filarioid nematode parasite in Finnish cervids

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Extended abstract:

Introduction
The filarioid nematode *Setaria tundra* was first described in semi-domesticated reindeer in Arkhangelsk area, Russia, in 1928. *Setaria* sp. infections appear to have emerged in Scandinavian cervids in the late 1960s. In 1973, *S. tundra* was observed for the first time in northern Norway where there was an outbreak of peritonitis in reindeer. Also in 1973, tens of thousands of reindeer died in the northern part of the Finnish reindeer husbandry area. Severe peritonitis and large numbers of *Setaria* sp. worms were commonly found. Following this, the incidence of *Setaria* sp. infection in reindeer in Scandinavia diminished.

Peritonitis outbreak
According to meat inspection data and clinical reports from practising veterinarians, an outbreak of peritonitis in reindeer started in 2003 in the southern and middle part of the Finnish reindeer herding area. The outbreak was caused by *Setaria* nematodes. In the province of Oulu, the proportion of reindeer viscera condemned in meat inspection due to parasitic lesions increased from 4.9% in 2001 to 47% in 2004 and in Lapland from 1.4% in 2001 to 43% in 2005. The focus of the outbreak moved approximately 100 km north yearly so that in the year 2005 only the reindeer in the northernmost small part of Finland were free of associated changes. In the same time the outbreak seems to have settled in the southern area. Peritonitis was common both in adults and calves but the degree of peritonitis was much more severe in calves. The habitus of heavily infected calves expressed decreased welfare; low body condition and undeveloped winter coat. The meat inspection findings of peritonitic reindeer carcasses included ascites fluid, green fibrin deposits, adhesions and live and dead *S. tundra* nematodes. Histopathologically, changes indicated granulomatous peritonitis with lymphoplasmacytic and eosinophilic infiltration. No specific bacterial growth was found. No significant impact on meat pH values nor on organoleptic evaluation of meat was found. There was a significant positive correlation between worm count and the degree of peritonitis and a negative correlation between the degree of peritonitis and back fat layer. The present study revealed that *S. tundra* can act as a significant pathogen for reindeer, which was evident at both *ante* and *post mortem* inspection and in histological examination.

Setaria tundra
The causative parasite was morphologically and molecular biologically indistinguishable from *Setaria tundra*. The genus *Setaria* includes 43 species found in the abdominal cavities of artiodactyls. All these species produce microfilariae (mf) which are present in host blood where they are available to the arthropod vectors. The mfs are taken up in the blood meal of the vector where they develop into the infective third larval stage. When the vector feeds again, the larvae break out and enter the tissue of the definitive host.

Microfilariae
In order to gain knowledge about the basic biology, epidemiology and transmission dynamics of this parasite, blood samples for *S. tundra* microfilariae (smf) were collected from reindeer and other cervids during the follow-up period 2004 to 2006. The prevalence and densities of smf were higher in reindeer calves than in adults, overall prevalence being 42%. The focus of microfilaremia moved north and settled down in the south simultaneously with the peritonitis outbreak. The peak microfilaremia occurred in the first summer after the infection and smf disappeared from the blood after two years.

Captive reindeer were smf positive over the year. The pre-patent period of *S. tundra* was estimated to be about 4 months, and the life span at least 14 months.

Wild cervids

In order to monitor the parasite dynamics in nature, parasite samples from wild cervids were also collected (moose, white-tailed deer, roe deer and wild forest reindeer). In moose, only few cases of pre adult encapsulated *S. tundra* nematodes on the surface of the liver but no peritonitis were detected. Two roe deer examined fresh in the field had *S. tundra* nematodes in abdomen but no peritonitis. Of 34 wild forest reindeer, 62% had changes associated with *S. tundra*. It is not known if the high percentage of wild forest reindeer shot in Kainuu with signs of peritonitis caused by *S. tundra* is associated with the decrease of the population from 1700 individuals in 2001 to 1000 in 2005. The overall smf prevalences for moose, wild forest reindeer and roe deer were 1.4-1.8%, 23% and 39%, respectively. No smf were found in any of 17 white-tailed deer examined.

Antiparasitic treatment

Ivermectin was efficient against adult *S. tundra* and its smf. Autumn, and to a lesser degree summer, treatment of reindeer calves with injectable ivermectin resulted in decreased severity of peritonitis and perihepatitis in reindeer calves due to setariosis. In the case of necessity for animal welfare reasons, treatment during early autumn round ups should be considered. On the population level, massive and routinely applied antiparasitic treatments can improve the health of breeding reindeer and decrease the mortality and the number of carriers but during the outbreak could not prevent its movement and expansion to the north.

Vectors

Mosquitoes, particularly *Aedes* spp. and to a lesser extent *Anopheles* spp., have an important role in the transmission of *S. tundra* in the reindeer herding areas of Finland. The prevalence of Finnish mosquitoes naturally infected by *S. tundra* varied from 0.5 to 2.5%. The rate of development in mosquitoes was temperature dependent. Infective larvae were present approximately 14 days after a blood meal in mosquitoes maintained at room temperature (mean 21 °C), but did not develop in mosquitoes maintained outdoors for 22 days at a mean temperature of 14.1 °C. The third-stage (infective) larvae had a mean length 1411 μm (SD 207), and width 28 μm (SD 2).

Dynamics

Warm summers apparently promote transmission and genesis of disease outbreaks by favouring the development of *S. tundra* in its mosquito vectors, by improving the development and reducing frost mortality of mosquitoes, and finally by forcing the reindeer to flock and stay on mosquito rich wetlands. Thus we predict that an anticipated change to warmer climate has the potential to promote the further emergence of filarioid nematodes and the disease caused by them in the north-boreal and subarctic areas.

This presentation is based on:

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Reindeer Forage and Supplementary Feeding in a Changing Climate

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Reindeer herding and its operational environment have changed in many ways in Finnish Lapland during the last decades. The pastures have been overused and during recent years also the availability of reindeer winter forage has deteriorated due to changes in winter climate. Consequences of extreme weathers, such as ice encasement and/or exceptionally thick snow cover have aggravated the digging conditions and availability of forage of reindeer. The aim of our research is to get new information for modelling good feeding practice and to develop methods of supplementary feeding as environment-friendly as possible. In the biological section of this project, we will study experimentally the effect of supplementary feeding of reindeer on the species composition and soil characteristics of sub-xeric heath forest. The aim of the anthropological section of this research is to study the experience-based knowledge of the reindeer herders about reindeer feeding and the related traditions. This research will be conducted in reindeer herding co-operatives of Hammastunturi, Oraniemi and Kuukas in co-operation with local reindeer herders. The research is based on exchange of know-how between the southern and northern reindeer herding districts, feeding experiments in the field, monitoring of reindeer, vegetation mapping, interviews of reindeer herders and participatory observation in field work. Experience-based knowledge about reindeer forage and supplementary feeding will be collected from the reindeer herders, and combined with scientific knowledge. Results of our project will be useful for the development of reindeer herding as a source of livelihood particularly in the northern reindeer herding districts.

Poron ravinto ja lisäruokinta muuttuvassa ilmastossa

Poronhoito ja sen toimintaympäristö ovat muuttuneet Suomen Lapissa monin eri tavoin viime vuosikymmenten aikana. Viime vuosina poron talviravinnon saatavuus on heikentynyt muuttuvan talvi-ilmaston vuoksi. Äärevien säiden seuraukset, kuten lumettoman maan pinnalle muodostunut jääkuori ja/tai poikkeuksellisen paksu lumipeite ovat vaikeuttaneet porojen kaivuuolosuhteita ja ravinnon saantia luonnonlaitumelta. Tutkimuksen tavoitteena on tuottaa uutta tietoa poron ruokinnan hyvän toimintatavan malliin ja kehittää porojen lisäruokintamenetelmiä mahdollisimman ympäristöystävällisiksi. Tutkimuksessa biologisessa osuudessa selvitetään kokeellisesti lisäruokinnan vaikutus kuivan kangasmetsän kasvipeitteen lajikoostumukseen ja maaperän ominaisuuksiin muuttuvassa ilmastossa. Tutkimuksen antropologisen osuuden tavoitteena on selvittää tutkimus-paliskuntien poronhoitajien oma tietous poron ruokinnasta ja siihen liittyvistä perinteistä. Tutkimus suoritetaan Hammastunturin, Oraniemen ja Kuukaan paliskunnissa yhteistyössä paikallisten poron-hoitajien kanssa. Tutkimus perustuu eteläisten ja pohjoisten paliskuntien välisen tietotaidon vaihtoon, porojen ruokintakokeisiin, porojen seurantaan, kenttäkerroksen kasvillisuuskartoituksiin, maaperämittauksiin sekä poronhoitajien haastatteluihin ja osallistuvaan havainnointiin yhteisissä kenttätöissä. Tutkimushankkeessa kerätään tutkimuspaliskuntien poronhoitajien kokemusperäinen tietous porojen ruokinnasta ja se yhdistetään tässä ja muissa hankkeissa tuotettavaan ja aiempaan tieteelliseen tietoon. Tutkimustulokset hyödyttävät ja kehittävät poroelinkeinoa erityisesti poron-hoitoalueen pohjoisissa paliskunnissa.

Ecosystem services – solution for sustainable landscape management? Reindeer herding aspect in a case study of forest Lapland, Finland

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The concept of ecosystem services (ES) is rather new scientific invention, which can offer an approach to prevent ecological problems caused by human action, and to solve conflicts arising from land use questions. Since the ES were launched as a main tool of thinking in the Millennium Ecosystem Assessment 2005, there has been huge increasing interest towards them. Despite of the scientific, and also economical and political, enthusiasm for the ES approach, there has been published quite a few case studies yet. In our case study, we studied how the ES interface with the landscape planning and management in Forest Lapland, in northern Finland.
In this presentation, our aims are: 1) to introduce the methodology and various databases, which can be used in an applied research on the ES. We will 2) classify what ES various biotopes of the study area in Forest Lapland do offer, and 3) examine how the different land use forms affect to the provision of ES in the study area.
There has been a controversial debate about the land use in Forest Lapland for a long time. The main participants of this complicated issue are forestry people, reindeer herders and tourism actors, but also other local people, conservationists and gold diggers are relevant stakeholders. Especially the importance of tourism has increased a lot recently in terms of employment rate and income. At the same time forestry has been facing radical changes which have for example lead to the closure of Finland's northernmost pulp factory in Kemijärvi where the main part of the wood logged from Forest Lapland was processed.
Ecological processes are slow in the Arctic. Tree reproduction, photosynthesis and decomposition need time. Hence, the amount of energy stored in the ecosystems is low. Thus, the ecosystem is very fragile for sudden human impacts. Local flora and fauna have evolved and adapted to the harsh environmental conditions, but not to the high rates and impacts of modern land use change, like e.g. caused by forestry.
Methodologies of landscape ecology offer some basic tools to get a grip on ES research. We used remote sensing, geographical information systems (GIS), statistical analyses and interviews to build up a land use and landscape change database for ES analysis. The determination of ES was based on current ecological literature and interviews of people, whose livelihood has been dependent on nature's properties. On a regional scale we considered three reindeer herding districts (Ivalo, Lappi and Hammastunturi) of which the CORINE land-cover database provides current land-use data. Moreover, the GIS database includes: soil data, climate data, topographical data, DEM, road networks etc. Individual land use classes and other GIS data were merged to different polygons. These polygons were linked to selected ecosystem services and socio-economical gains and impacts.
Finally, we discuss about the opportunities and the pitfalls of the used methodology for ES research. The concept of the ES has great potential to introduce a new forum of discussion for different stakeholders and decision-makers to take ecosystem characteristics and the importance of biodiversity into account for sustainable landscape planning and management.

Ekosysteemipalvelut – ratkaisu kestävään maankäytön hallintaan? Poronhoidon näkökulma Metsä-Lapin tapauksessa

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Ekosysteemipalveluiden merkitys uutena lupaavana keinona ratkaista ihmisten toiminnasta aiheutuvia, ympäröivää luontoa uhkaavia ongelmia on herättänyt paljon kiinnostusta viime aikoina. Käsite nousi tutkijoiden tietoisuuteen Vuosituhannen ekosysteemiarvion (Millennium Ecosystem Assessment 2005) julkaisemisen jälkeen. Saamastaan mielenkiinnosta huolimatta ekosysteemipalveluiden tutkimuksessa käytetyistä aineistoista ja metodologiasta on toistaiseksi olemassa vain vähän julkaisuja.
Olemme tutkineet Metsä-Lapin ekosysteemien tuottamia hyödykkeitä ja prosesseja sekä erilaisten maankäyttömuotojen vaikutuksia kolmen paliskunnan alueella (Hammastunturi, Lappia ja Ivalo). Tässä työssä 1) esittelemme, millaisia aineistoja ja menetelmiä olemme soveltaneet ekosysteemipalveluiden tutkimisessa; 2) luokittelemme, mitä ekosysteemipalveluja tutkimusalueella esiintyvät biotoopit tuottavat; sekä 3) tarkastelemme, miten erilaiset maankäyttömuodot vaikuttavat ekosysteemipalveluiden tuotantoon.
Metsä-Lapin maankäytöstä on keskusteltu ja kiistelty pitkään. Pääosapuolina maankäyttöä koskevassa kiistassa ovat olleet metsätalouden, matkailun ja poronhoidon edustajat, edellä mainittujen tahojen lisäksi tärkeitä osapuolia ovat alueen asukkaat, retkeilijät ja luonnon virkistyskäyttäjät, kullankaivajat sekä luonnonsuojelun puolestapuhujat ja viranomaiset. Erityisesti matkailun merkitys alueellisesti tärkeänä elinkeinona on viime vuosina kasvanut merkittävästi. Samaan aikaan metsäteollisuuden ja metsätalouden toimintaympäristössä on tapahtunut merkittäviä muutoksia, joiden seurauksena on mm. suljettu Kemijärvellä sijainnut Suomen pohjoisin sellutehdas. Myös kaivosteollisuuden vaikutukset ekosysteemipalveluiden paikalliseen tuotantoon voivat olla merkittäviä, ja alan toiminta on viime aikoina vilkastunut monin paikoin Pohjois-Suomessa.
Arktisten ja subarktisten alueiden biologiset prosessit ovat hitaita. Yhteyttäminen, biomassan tuottaminen (puu mukaan lukien) ja hajottaminen vaativat aikaa – ekosysteemien käytettävissä oleva energiamäärä on alhainen verrattuna lämpimämpiin alueisiin. Muun muassa näistä syistä johtuen pohjoisten alueiden ekosysteemit ovat hyvin herkkiä ihmistoiminnasta, kuten esimerkiksi metsätaloudesta, aiheutuville nopeille maankäytön muutoksille.
Ekosysteemipalvelututkimuksessa voidaan soveltaa monilta osin menetelmiä, joita on kehitelty esim. maisemaekologiassa. Kartoitimme tutkimusalueelta saatavissa olevat paikkatieto- ja kaukokartoitusaineistot, joita on saatavilla runsaasti. Pääasiallisena paikkatietoaineistona käytimme koko Euroopan kattavaa yhtenäistettyä CORINE 2000 -maanpeittoluokitusta. CORINEn ja Maanmittauslaitoksen, Metsähallituksen, Paliskuntain yhdistyksen, kaivosrekisterin, Tielaitoksen, Ympäristökeskuksen ja muinaisaineistorekisterin paikkatietoaineistojen avulla selvitettiin alueen maankäyttömuodot. Lopuksi arvioitiin eri maanpeittoluokkien ja maankäyttömuotojen merkittävyyttä ekosysteemipalvelujen tuotantoon paliskunnittain.
Lopuksi pohdimme ekosysteemipalvelumenetelmän mahdollisuuksia ja heikkouksia. Ekosysteemipalvelujen vertailu tarjoaa kiistanalaiseen Metsä-Lapin maankäyttökysymykseen uuden lähestymistavan, jonka avulla voidaan huomioida erilaisista maankäyttömuodoista myös biodiversiteetille ja ekosysteemien toiminnalle aiheutuvia vaikutuksia. Ekosysteemipalveluiden konsepti tarjoaa uuden vuorovaikutuskeinon asiantuntijoiden, sidosryhmien ja poliittisten päätöksentekijöiden väliseen keskusteluun pohdittaessa ekologisesti, sosiaalisesti ja taloudellisesti tasapainoista suhdetta eri maankäyttömuotojen välillä

Condition and use of reindeer winter pastures in the nature conservation areas in northern Lapland

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Extended abstract: In Finland 84%, all the nature conservation areas are situated in the reindeer herding area which includes nearly 30% of the total land area. The amount of the protected land area increases considerably in the northern part called designated reindeer herding area, and 74% of all the national parks and strict nature reserves in Finland are here. Nature parks and strict nature reserves are the essence of Finnish nature conservation and reindeer husbandry has legal rights to use these areas as pastures. According to a questionary research the attitudes of chairmen of 26 reindeer herding co-operatives towards nature conservation were very positive. The pastures in the protected areas were considered to be in better condition than elsewhere because there is no forestry in those areas. These areas are important especially in the winter (according to 39% of the chairmen) and spring (30%) (Forsblom *et al*., 2006).

The aim was to study the condition, use and amount of reindeer winter pastures in nature parks and strict nature reserves of northern Lapland compared to other areas. The assumption was that nature conservation has had positive effects on winter pastures. The study areas were the Kevo nature reserve (712 km^2) in the reindeer herding co-operative of Paistunturi, the Lemmenjoki nature park (2856 km^2) in the herding co-operatives of Muotkatunturi, Sallivaara and Kuivasalmi, the Pallas-Yllästunturi nature park (1020 km^2) in the herding co-operatives of Näkkälä, Kyrö, Muonio and Alakylä, the Urho Kekkonen nature park (2541 km^2) in the herding co-operatives of Ivalo, Lappi and Kemin-Sompio, the Sompio nature reserve (179 km^2) in Lappi and the Maltio nature reserve (148 km^2) and part of the Värriö nature reserve (125 km^2) in Kemin-Sompio. The state of the lichen pastures was determined by using the measurements of the reindeer research station in two hectares wide experiment sites in 363 locations in lichen heaths. The vegetation cover, lichen (*Cladina*, *Cladonia* spp.) height and biomass were measured using 0.25 m^2 wide vegetation plots. The amount of arboreal lichens (*Alectoria*, *Bryoria* sp.) was estimated from trees in the reach of a reindeer (< 2 m) inside the diameter of 4 m wide circles. The acreages of lichen, arboreal lichen, leaf, dwarf shrub and grass pastures were calculated from the satellite image modifications using ArcGIS 8.3 software (Kumpula *et al*., 2004; Nieminen, 2008).

The lichen pastures in the whole study area were heavily grazed. But the height, cover and biomass of reindeer lichens were usually significantly higher in the protected areas compared to other areas. In the nature parks and strict nature reserves, the cover and the biomass classifies the lichen mat as being in a slowly renewing state and the height as being in a heavily deteriorated state (Forsblom, 2007; Nieminen, 2008). However, in the Lemmenjoki nature park and Kevo nature reserve the height of lichens were slightly lower. Also in the Pallas-Yllästunturi nature park the height was slightly lower and cover and biomass were significantly lower compared to other areas. The Kevo nature reserve and the Pallas -Yllästunturi nature park were the most heavily grazed; only a negligible amount of arboreal lichens were available in the Kevo. The cover of dwarf shrubs in the lichen heaths was significantly higher outside the protected areas but there was not significant difference in the cover of grasses. There were small amounts of arboreal lichens in the co-operatives but significantly more in the lichen heaths of the Lemmenjoki nature park, slightly more in the Pallas-Yllästunturi nature park, and significantly less in the Urho Kekkonen nature park compared to areas outside. According to satellite image modifications there were more winter pastures and less summer pastures in proportion to land acreage in the nature parks and strict nature reserves compared to other areas. The density of reindeer exceeds the reference values in herding co-operatives of the Lemmenjoki and Pallas-Yllästunturi nature parks. The state of the winter pastures in the protection areas was preferable compared to other areas but to meet the protection aims the number of reindeer must be kept lower in reindeer herding co-operatives.

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Poron talvilaidunten kunto ja luonnonsuojelualueilla Pohjois-Lapissa

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Suomessa 84% kaikista luonnonsuojelualueista sijaitsee poronhoitoalueella, joka on noin 30% koko maa-alasta. Suojellun alueen määrä lisääntyy suuresti pohjoisosassa ns. erityisellä poronhoitoalueella, ja 74% kaikista Suomen kansallispuistoista ja luonnonpuistoista sijaitsee tällä alueella. Kansallis- ja luonnonpuistot ovat tärkeitä Suomen luonnonsuojelulle, ja porotaloudella on oikeus käyttää myös näitä alueita. Kyselytutkimuksen mukaan puistopaliskuntien poroisännät (N=26) suhtautuivat luonnonsuojeluun hyvin positiivisesti. Kansallis- ja luonnonpuistojen laidunten arveltiin myös olevan paremmassa kunnossa, koska alueilla ei ollut metsätaloutta. Nämä alueet olivat erityisen tärkeitä laitumia talvella (39%) ja keväällä (30%) (Forsblom *et al.*, 2006). Tarkoituksena oli tutkia talvilaidunten kuntoa, käyttöä ja määrää Pohjois-Lapin kansallis- ja luonnonpuistoissa. Oletuksena oli, että luonnonsuojelulla olisi ollut positiivisia vaikutuksia talvilaitumiin ja niiden kuntoon. Tutkimusalueena oli Kevo luonnonpuisto (712 km^2) Paistunturin paliskunnassa, Lemmenjoen kansallispuisto (2856 km^2) Muotkatunturin, Sallivaara ja Kuivasalmen paliskunnissa, Pallas-Yllästunturin kansallispuisto (1020 km^2) Näkkälän, Kyrön, Muonion ja Alakylän paliskunnissa, Urho Kekkonen kansallispuisto (2 541 km^2) Ivalon, Lapin ja Kemin-Sompion paliskunnissa, Sompion luonnonpuisto (179 km^2) Lapin paliskunnassa ja Maltion luonnonpuisto (148 km^2) ja osa Värriön luonnonpuistoa (125 km^2) Kemin-Sompiossa. Jäkälälaidunten kunto määritettiin porolaiduninventointien yhteydessä 363 koealueelta. Kasvillisuuden peittävyys, jäkälien (*Cladina*, *Cladonia* spp.) pituus ja biomassa mitattiin 0,25 m^2:n kasvillisuusruuduilta. Lupon (*Alectoria*, *Bryoria* spp.) määrä arvioitiin koko puusta ja poron ulottuvilta (< 2 m) 4 m:n ympyräkoealoilta. Jäkälä-, luppo-, lehti-, varpu- ja ruoholaitumien pinta-alat laskettiin satelliittikuvatulkinnoista ArcGIS 8.3 -ohjelmistolla (Kumpula *et al*., 2004; Nieminen, 2008).
Jäkälälaitumet olivat kovin kuluneita koko tutkimusalueella. Jäkälien pituus, peittävyys ja biomassa olivat yleensä merkitsevästi suurempia luonnonsuojelualueilla kuin niiden ulkopuolella. Kansallispuistoissa ja luonnonpuistoissa jäkälien peittävyys ja biomassa olivat hitaasti uudistuvassa tilassa, pituus kovin lyhyttä. (Forsblom, 2007; Nieminen, 2008). Lemmenjoen kansallispuistossa ja Kevon luonnonpuistossa jäkälä oli vielä hieman lyhyempää. Myös Pallas-Yllästunturin kansallispuistossa jäkälä oli hieman lyhyempää, mutta peittävyys ja biomassa merkitsevästi pienempiä kuin muilla alueilla. Kevon luonnonpuisto ja Pallas-Yllästunturin kansallispuisto olivat kuluneimpia, ja vain vähän oli luppoa Kevolla. Jäkäläkankailla varvut olivat merkitsevästi korkeampia puistojen ulkopuolella, mutta heinien peittävyydessä ei ollut eroa. Paliskunnissa luppoa oli vähän, mutta luppoa oli merkitsevästi enemmän Lemmenjoen kansallispuistossa, hieman enemmän Pallas-Yllästunturin kansallispuistossa mutta merkitsevästi vähemmän Urho Kekkonen kansallispuistossa kuin ulkopuolisilla alueilla. Satelliittikuvatulkintojen mukaan kansallis- ja luonnonpuistoissa oli maa-alaan suhteutettuna enemmän talvi- ja vähemmän kesälaitumia kuin niiden ulkopuolella. Sopivat porotiheydet ylittyivät Lemmenjoen ja Pallas-Yllästunturin kansallispuistoissa. Talvilaidunten kunto oli kansallis- ja luonnonpuistoissa hieman parempi kuin niiden ulkopuolella, mutta suojelun ja laidunten kuluneisuuden vuoksi laidunnuspainetta pitäisi alueen paliskunnissa vähentää.

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State subsidies to reindeer husbandry in Finland

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Expanded abstract: Government use subsidies for many reasons. Subsidies may be applied to help struggling industry, to redistribute incomes, to adjust to changed economic circumstances, to protect environment or to meet certain non-economic objectives. Subsidies are sometimes provided in the name of non-trade concern or cultural heritage and diversity. These are generally considered as objectives that are crucial to the identity of a nation, even if they have a specific sectoral focus.
Agriculture is widely related to non-trade concerns. The term multifunctionality is also used in this connection. The argument is that agricultural production is a process of joint production where not only commodities such as food are produced, but also "non-commodities" that exhibit the characteristics of positive externalities. Examples of such include landscape, cultural heritage values, biodiversity, rural employment and animal welfare.
In Finland, reindeer husbandry is practiced through a system of reindeer herding cooperatives. There are over fifty cooperatives and a part of them are located in areas, which are populated by Sami. Reindeer husbandry is governed under the Finnish Ministry of Agriculture and Forestry. The EU defines reindeer husbandry as the production of foodstuffs. With respect to support policy, reindeer husbandry falls within the sphere of agriculture. EU is currently reforming the system of agricultural subsidies and is underway transferring subsidy to land stewardship rather than specific corp production. During the last years the situation has been turning controversial. In Finland the farmers may take advantage of various support payments based on the rights of arable area. But reindeer owners have more restricted possibilities to receive support because of limited property rights to the husbandry area.
The aim of this paper is to describe different subsidy instruments and the support level paid to reindeer husbandry. The direct supports can be divided in two categories: Support for live reindeer and investments' aid. In average total revenue of Finnish reindeer husbandry has been 17 million euros. The share of direct support has been below twenty per cents. Also long-run support instruments are used in reindeer husbandry. The support to research, development and advisory work has been annually few million euros. Subsidies are mostly financed by Finnish national budget. The beginners in the reindeer husbandry have only been eligible for aid funded partly from the European Agricultural Fund for Rural Development.

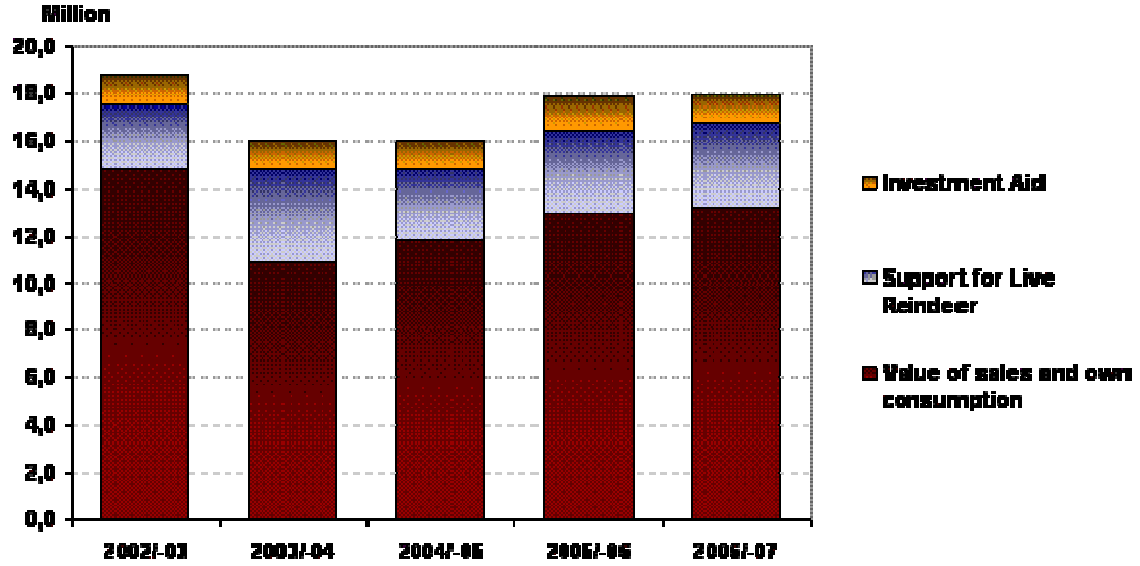

Fig. 1. Total revenue of reindeer husbandry in 2002- 2007.

Apart from direct and indirect support, reindeer husbandry is receiving compensations for damages caused by predators and traffic accidents.
Total revenue of reindeer husbandry has been annually varying between 16 and 18 million euros. The support for live reindeer is the most significant instrument for direct support. The level of support is determined annually and is evaluated by market situation and environmental conditions. The total

support is based on the amount of live reindeer and the support level. EU has determined 27 Euros per reindeer as the maximum level. Only in 2002/2003 reindeer husbandry has been able to receive maximum support for exceptionally difficult market situation.

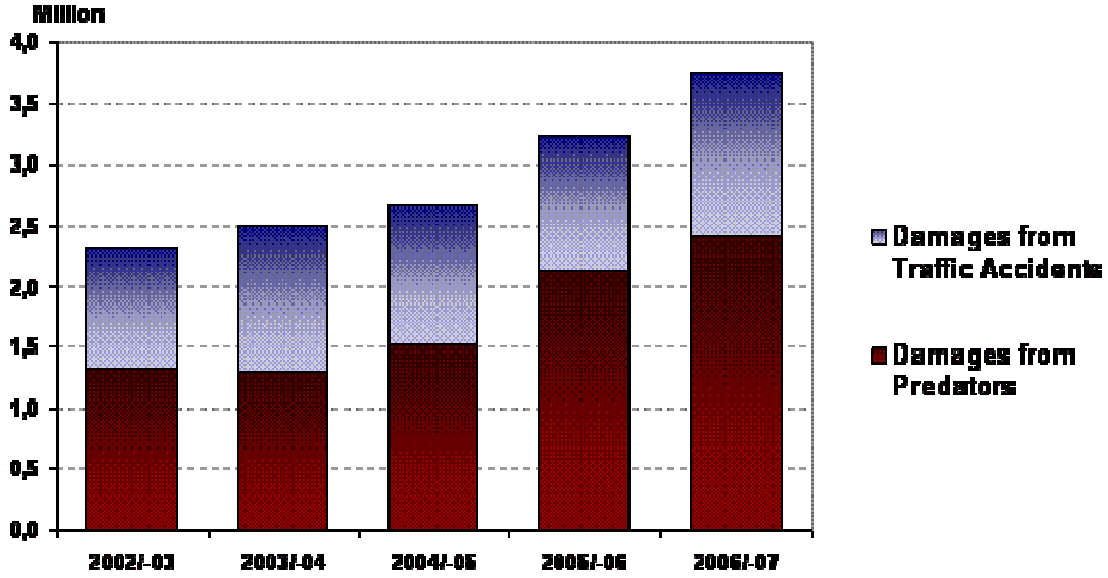

Fig. 2. The amount of compensations to the reindeer husbandry in 2002- 2007.

The reindeer husbandry has been struggling with changes in the surrounding environments. The loss caused by traffic accidents have maintained on stable levels and the compensations for damages to reindeer has been annually about one million euros. However the increasing populations of large carnivores have been unconvinced reindeer husbandry in various part of Northern Finland. The compensations of damages has more than doubled during the last five years.
The aid for investments is annually one to one and half million euros. Most of it is placed to herding cooperatives, which reconstruct fences between cooperatives or purchase vehicles. National investments aid to reindeer herders are most commonly used in buying cross-country vehicles. The only subsidy the EU has been partly supported has been the investment aid to the beginners in the reindeer husbandry. They have been able receive support for basis investments such as acquiring buildings or reindeer cattle.

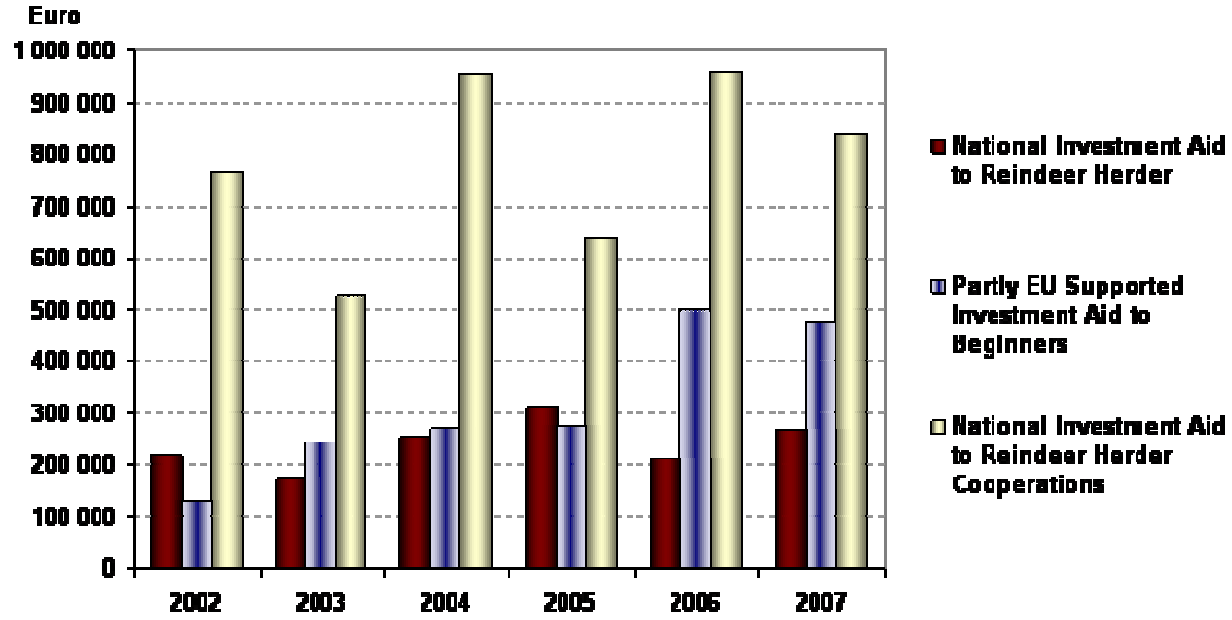

Fig. 3. The amount of investment aids to the reindeer husbandry in 2002- 2007.

References: Reindeer herders' association, Ministry of Agriculture and Forestry, Ministry of Finance, TE-Central in Lapland, European Commission, WTO, World Trade Report 2006.