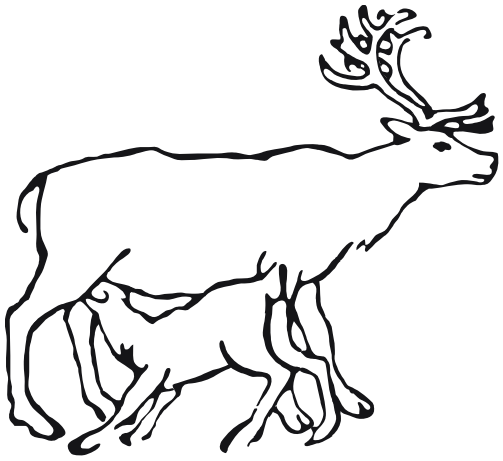
NOR:s 15:e nordiska forskningskonferens om ren och renskötsel
The 15th Nordic Conference on Reindeer and Reindeer Husbandry Research

Luleå, Sverige, 26 - 29 januari 2009
Luleå, Sweden, 26th - 29th January 2009

Renskötseln och omvärlden
Reindeer husbandry and the surrounding world

Sammandrag och presentationer
Abstracts and presentations



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Nordisk Organ for Reindriftsforskning (NOR) ble etablert i 1980 og har vedtekter vedtatt av Nordisk Ministerråd (landbruksministrene) i 2003. Organet er et samarbeidsorgan mellom Finland, Norge og Sverige. Med reindriftsforskning menes naturfaglig, samfunnsfaglig/ humanistisk og annen forskning om problemstillinger knyttet til reinen som dyr og reindriften som næring og kultur. Formålet er å fremme forskning og forskningssamarbeid til nytte for reindriftsnæringen i de nordiske land. Virksomheten finansieres ved direkte bidrag fra deltakerlandene.

Nordic Council for Reindeer Husbandry Research (NOR) was founded in 1980 to promoting cooperation in research on reindeer and reindeer husbandry. From 1993 the organisation is under the auspices of the Nordic Council of Ministers (the Ministers of Agriculture). The work of NOR depends on funds from the member governments (Finland, Norway and Sweden).

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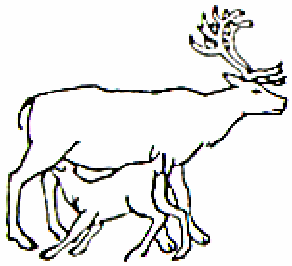

Abstracts and presentations
Sammandrag och presentationer

NOR:s 15:e nordiska forskningskonferens om ren och renskötsel
Luleå, 26 - 29 januari 2009

The 15th Nordic Conference on Reindeer and Reindeer Husbandry Research
Luleå, 26th-29th January 2009

SLU

Swedish University of Agricultural Sciences

Editors / Redaktörer

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15th Nordic Conference on Reindeer and Reindeer Husbandry Research
26th-29th January 2009, Örnvik Conference Hotel, Luleå, Sweden

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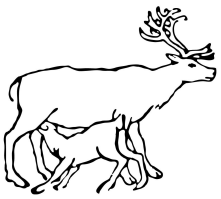

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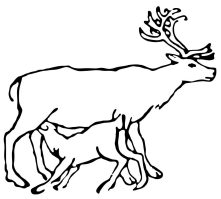

15e Nordiska konferensen om ren och renskötselforskning

Renskötseln och omvärlden, 26-29 januari 2009

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10.30-10.50 Nataša Djaković, Simlenes organisering og romlige fordeling under brunst – p.32

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Lectures – Föredrag [1]

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[1] Inbjudna talare i fet stil. / Invited speakers in bold.

Posters / Posterpresentationer [1]

Sessions / Sessioner I-III
Climate, Disturbance, Predation / Klimat, Störning, Predation

[1]Conference' participants in bold. / Deltagare står med fet stil.

Sessions / Sessioner IV-V
Production, Health, Society / Produktion, Hälsa, Samhälle

Compensation for carnivore killed reindeer and lynx survey

Henrik Andrén[1], **John Linnell**[2] **& John Odden**[2]
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The compensation for predator-killed reindeer in Sweden is dependent on the number of predators in the reindeer management units (districts, villages). The quality of the survey of predator populations (lynx, wolverine, wolf, bear and golden eagle) will therefore be essential for the compensation system to function correct and just. Furthermore, the management of predators in both Sweden and Norway needs high quality survey to make informed management decisions (e.g. hunting quotas).
The aim with the survey is to find all lynx family groups and to accurately separate between different groups. The lynx survey in Sweden and Norway is performed in January and February by snow tracking. Tracks from two or more individuals are considered to be a lynx family group, i.e. an adult female with her offspring (9 months old).
In Sweden, one tries to separate between two neighbouring family groups by simultaneous tracking. When this is not possible, an alternative is to use the distance between two family groups. If this distance exceeds 25 km they should be considered two separate lynx family groups and compensation will be given accordingly.
In Norway, the number of lynx family groups in an area is estimated from the accumulated observations of such groups. The observations are grouped together into separate family groups using distance criteria. However, the use of the distance criteria might cause some misclassifications, i.e. one family group may be classified as two groups (over-estimation) or two neighbouring groups may be counted as one group (under-estimation). We used GPS-marked female lynx with kittens to estimate both errors.
The family groups are only a segment of the total lynx population and one multiplies the number of family groups by approximately 5.5 to 6 to get the total lynx population. However, there is large between-year variation in this factor due to differences in reproduction and survival of the kittens from birth to mid winter (Jan and Feb). Thus, the total adult lynx population might be the same even if the number of family groups has changed from one year to another. Such erroneous interferences may have large consequences for reindeer and carnivore management as the compensation is based on the number of family groups whereas losses might more closely correlate with the size of the total lynx population.

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Andrén, H., Linnell, J.D.C., Liberg, O., Ahlqvist, P., Andersen, R., Danell, A., Franzén, R., Kvam, T., Odden, J., & Segerström, P. 2002. Estimating total lynx (*Lynx lynx*) population size from censuses of family groups. – *Wildlife Biology* 8: 299-306.

Linnell, J.D.C., Odden, J., Andrén, H., Liberg, O., Andersen, R., Moa, P., Kvam, T., Brøseth, H., Segerström, P., Ahlqvist, P., Schmidt, K., Jedrejewski, W., Jędrezejewski, W., & Okarma, H. 2007. Distance rules for minimum counts of Eurasian lynx *Lynx lynx* family groups under different ecological conditions. – *Wildlife Biology* 13: 447-455.

Ersättning för rovdjursdödade renar och loinventering

Henrik Andrén[1], **John Linnell**[2] **& John Odden**[2]
[1]Grimsö forskningsstation, Institutionen för ekologi, Sveriges lantbruksuniversitet (SLU), SE-730 91 Riddarhyttan, Sverige (henrik.andren@ekol.slu.se); [2]Norsk institutt for naturforskning (NINA), N-7485 Trondheim, Norge (john.linnell@nina.no; john.odden@nina.no).

Ersättningssystemet för rovdjursdödade renar i Sverige bygger på antalet rovdjur i en sameby. Kvalitén på inventeringarna av rovdjurspopulationerna (lodjur, järv, varg, björn och kungsörn) är därför avgörande för att ersättningssystemet ska vara rättvist. Dessutom behöver rovdjursförvaltningen i både Sverige och Norge inventeringar av hög kvalité för att kunna ta välgrundade förvaltningsbeslut (t.ex. jakttilldelning).
Målsättningen med loinventeringen är att hitta alla lodjursfamiljegrupper och att särskilja närliggande familjegrupper. Loinventeringen i Sverige och Norge genomförs i januari och februari med hjälp av snöspårning. Spår från två eller fler individer tillsammans tolkas som en familjegrupp, d.v.s. en vuxen hona med sina ungar (9 månader gamla).
I Sverige är målet att särskilja närliggande lofamiljegrupper med hjälp av detaljerad snöspåring. Om detta inte har varit möjligt kan man använda avståndet mellan två familjegrupper. Om detta avstånd är mer än 25 km ska familjegrupperna klassificeras som två olika och ersättning ska utgå för båda grupperna.
I Norge beräknar man antalet lofamiljegrupper utifrån ackummulerade observation av familjegrupper. Efter inventeringen sammanställer man alla observation och särskiljningen mellan olika lo-familjegrupper bygger på avståndskriterier. Men avståndskriterier kan leda till felbedömningar, d.v.s. en familjegrupp kan klassas som två (överskattning) eller två närliggande familjegrupper kan klassas som en (underskattning). Vi har studerat GPS-märkta lodjurshonr med ungar för att beräkna dessa både felen.
Familjegrupper utgör bara ett segment av den totala lopopulationen och man ska multiplicera antalet familjegrupper med ungefär 5,5 till 6 för att få fram den totala lopopulationen. Men det finns en stor mellanårsvariation i denna faktor beroende på skillnader i reproduktion och ungarnas överlevnad från födseln till vintern (januari - februari). Den totala vuxna lopopulationen kan vara ungefär densamma även om antalet familjegrupper har förändrats från ett år till nästa. Denna mellanårsvariation har stor betydelse för renskötseln och rovdjursförvaltningen eftersom ersättningssystemet bygger på antal familjegrupper medan förlusterna troligen är bättre relaterat till storleken på den totala lopopulationen.

Litteratur

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Genetic profile of domestic reindeer of northern Fennoscandia through a century

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Reindeer has been kept as a domesticated animal for several hundred years in northern Fennoscandia, and traditional Sami reindeer herding has been based on seasonal migrations independent of national boundaries. However, the national borders between the Nordic countries and Russia were closed in the 19th century, restricting the seasonal movements and interactions within the region. To address the effect of hindering migrations and genetic exchange between countries within the Sami areas, we examined the genetic composition of northern Fennoscandian reindeer collected in the years 1909 to 1911 and compared with the genetic constitution of contemporary reindeer from the same areas. Mitochondrial control region sequence data shows that northern Fennoscandian domestic reindeer was a homogenous population a hundred years ago with little differentiation among the countries. The genetic profile of reindeer from Finnmark has changed little within a hundred years. On the other hand, anthropogenic activity of effectively ending genetic exchange within this region has changed the genetic constitution of contemporary Russian Kola reindeer, making it more prone for eastern influence.

Genetisk profil av tamrein fra nordlige Fennoskandia gjennom et århundre

Tamreindrift har eksistert i flere århundrer i det nordlige Fennoskandia, og tradisjonelt samisk reinsdyrhold er basert på sesongmessige vandringer uavhengig av nasjonale grenser. Da grensene mellom de nordiske land og Russland ble stengt på 1800-tallet, ble de sesongmessige trekkrutene og interaksjoner over landegrenser innen regionen svært begrenset. For å undersøke virkningen av en effektiv stopper av det tradisjonelle trekkmønsteret og hindring i genetisk utveksling mellom landene innen de samiske områdene, undersøkte vi den genetiske sammensetningen av nordlige Fennoskandiske reinsdyr innsamlet i årene fra 1909 til 1911, og sammenliknet den med den genetiske sammensetningen av reinsdyr fra de samme områdene i dag. Sekvensdata fra den mitokondrielle kontrollregionen viser at tamrein fra Nordkalotten var en homogen bestand for hundre år siden, med liten differensiering mellom land. Den genetiske profilen av reinsdyr fra Finnmark har forandret seg lite i løpet av hundre år. På Kolahalvøya er situasjonen derimot en annen, hvor menneskelig aktivitet effektivt har satt en stopper for genetisk utveksling innen regionen, endret den genetiske sammensetningen av dagens reinsdyr, og gjort den mer tilgjengelig for østlig innflytelse.

Dialog as a tool in conflict resolution

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The lecture will present the experiences from the use of dialog as a tool for communication in heavily divided communities, often with strong territorial disputes. Dialog focus more on the understanding of the conflict, and the relation between the parties in the conflict than on the solution itself.
Traditional conflict resolutions focus on conflicting values and interests, or the struggle over resources, power and territorial integrity. Although these are all important; the dialog approach focus more heavily on the perception/description of reality and the propaganda war as it is carried out in the homes, schools, media and political life.
This means that a strong dialog component in the meditation and negotiation processes will increase the chances of finding sustainable solutions. Nansen Dialog has visible results in the Balkans and Middle East and argues that dialog is often a neglected component in conflict resolution. The lecture will answer the questions; What is Nansen dialogue? When does it work? How does it work? For whom does it work?

The effect of large (300 and 420 kV) power lines on free-ranging, migratory and herded reindeer

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Numerous power lines transverse reindeer habitat throughout Scandinavia and their number and size in terms of voltage passing through them as well as their physical appearance are increasing. Reindeer may be disturbed by power lines and as a result, alter their feeding behaviour, range use, and large scale (migratory) or small scale (within season) movement patterns. Reindeer can also habituate towards power lines in the absence of negative interactions with power lines over time. However, when roads, houses/cabins or new, additional parallel power lines are introduced together with existing power lines, a cumulative effect of the combined infrastructure may cause even greater disturbance towards the reindeer than the existence of the one power line or single other disturbance factor would have done if they were not located in close vicinity to each other. This theory of "cumulative impacts", defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" and the presumed amplified negativity towards reindeer has never been thoroughly or experimentally tested.
We studied the interactions of free-ranging, migratory and herded semi-domestic reindeer while crossing under or using the area adjacent to a 300 kV power line. Using collars with GPS and GSM technology, we collected the positions of up to 22 female reindeer every 15 minutes while near the power line from October 2007 and until the present. On a relatively small scale (within 1 km), we tested the rate (speed and direction over time) between eight consecutive positions in conjuncture with crossing beneath the power line; four before the crossing and four after the reindeer crossed the power line. We also compared these to an equal number of eight consecutive positions randomly chosen from control areas at various increasing distances away from the power line and controlled for important environmental variables such as elevation. At a larger geographical scale, we also tested the success of migratory movements and herding attempts by the reindeer herdsmen while shifting between the herd's winter and summer ranges and round-ups in the area adjacent to the power line. During summer 2008, a new 420 kV power line was constructed along the same corridor as the existing 300 kV power line. Data will be gathered until 2012. We can then experimentally test on a large, free ranging scale the cumulative affects of the two power lines together before and after the original 300 kV power line is removed in 2010.

Effekten av store kraftledninger (300 og 420 kV) på atferd hos tamrein

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Som et resultat av økende energibehov bygges stadig flere kraftledninger i hele Skandinavia og mange av disse går på tvers av reinsdyrhabitater. I tillegg til et økende antall traséer, brukes nå høyere spenning og større master. Kraftledninger kan virke forstyrrende på reinsdyr, og effekten kan man se som endringer i reinens bevegelsesmønster (stor skala: migrasjon mellom sesongbeiter, og liten skala: innen sesongbeitet), beiteatferd og områdebruk. Man kan også se habitueringseffekter hos reinsdyr dersom ingen negative interaksjoner oppstår i forbindelse med kraftledningene over tid. Imidlertid bygges ofte veger, hus, hytter eller nye parallelle kraftledninger i forbindelse med krafttraséer. Slike inngrep vil sammen kunne gi en kumulativ effekt, der summen av forstyrrelse på reinsdyr blir større enn om hvert enkelt inngrep hadde forekommet alene. Teorien om kumulative effekter defineres slik: ”Påvirkning av miljøet som kommer fra trinnvis økning av handling når den summeres med andre tidligere, nåværende og nært forestående handlinger.” Den antatt forhøyede effekt av flere forstyrrelsesfaktorer har ikke tidligere blitt grundig eller eksperimentelt testet.
Vi har studert interaksjoner hos tamrein som går fritt og migrerer mellom sesongbeiter, samtidig som at arealbruken til en viss grad styres av reineierne ved gjeting/driving. Vårt fokus har vært atferd ved kryssing under en 300 kV kraftledning, samt atferd ved bruk av områder nær denne. Ved bruk av halsbånd med GPS og GSM-teknologi ble geografiske posisjoner fra opptil 22 simlers lagret hvert 15 minutt, fra oktober 2007 til oktober 2008. På en relativt liten skala testet vi fart og retningsstabilitet ved kryssing under kraftledning. Ved å måle avstand mellom åtte påfølgende posisjoner, hvorav fire før og fire etter kryssing av kraftledning, fikk vi et godt mål på eventuelle endringer i bevegelseshastighet. For sammenligning valgte vi tilfeldig åtte punkter tilsvarende, i områder med ulik avstand fra kraftledningen. Vi kontrollerte disse for viktige uavhengige variabler, så som høyde over havet. På en større geografisk skala testet vi for suksess for migrasjon og drivingsforsøk gjort av reineierene ved flytting mellom vinter- og sommerbeiter og til reingjerder nær kraftledning. Sommeren 2008 ble anleggsarbeid for en ny 420 kV ledning som plasseres omtrent parallelt med eksisterende 300 kV ledning. Data for dette prosjektet skal samles inn hele året til og med år 2012. Dette materialet skal så brukes til eksperimentelle tester på stor skala for å studere kumulative effekter av de to kraftledningene sammen, både før og etter at den originale 300 kV kraftledningen skal fjernes i år 2010.

Wild predators but tame prey – consequences of large predators on reindeer industry

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The wild large predator populations in northern Fennoscandia have domesticated animals as key preys, whereof the semi-domesticated reindeer is the calculated main prey. Particularly in Sweden, the depredation is the single largest threat to the reindeer industry and hits it at several levels. The conditions of the reindeer industry in relation to the predators have received very limited attention in scientific as well as management contexts. Assessments of the extent of the depredation using a precautionary principle from the prey population's point of view indicate direct yearly losses of 45 000 to 50 000 reindeer in Sweden, approx. 20 000 in Norway and about 10 000 in Finland. This is equivalent to about 20% of the winter stock in Sweden, 8% in Norway and 5% in Finland.

The difference between using a domesticated prey population instead of wild prey as resource base for wild predators is fundamental. Domesticated stock, including reindeer, is a naïve prey as a result of the domestication process, and therefore more exposed and vulnerable than wild prey. Furthermore the domesticated animals are components in optimised production systems with important economic, social and cultural roles in human systems. In a well-functioning reindeer husbandry, the production consequence in terms of harvested numbers is around 1.7 times the number of killed animals. This is due to dynamic effects in an optimised herd, and even larger if nutritional consequences, resulting in worsen body condition and lower production, and hampered selection and culling possibilities are included. In addition to the direct and dynamic losses in the reindeer herd, the presence of predators makes the use and management of available grazing resources less efficient. Operationally, the occurrence of predators leads to worsened control of the animals on range, reduced predictability, increased unpaid labour inputs and operating costs, and difficulties to handle the animals.

Economically, reindeer husbandry is very vulnerable for predation due to the low turn over and limited business margins of the system, resembling what is common in "wild" systems. The decreased production also worsens the market price for reindeer products due to lower range, decreases the profitability in the processing industry and reduces the employment in the processing sector of the industry.

The social consequences are devastating due to traumatic experiences at meeting killed, wounded and disabled animal in the range, strong feelings of insecurity, uneasiness, distrust and powerlessness, as well as amplified conflicts with the surrounding world. An extremely serious consequence of the economic and social strains is the evident increase in mental illness during recent years especially among young people in the herder societies. The likely long-term consequence of this situation is that the profession as active reindeer herder becomes less attractive and the industry gets difficulties in recruiting young people to become herders.

The current depredation situation especially in Sweden, together with the strains caused by all other difficulties for the reindeer industry, seems to be almost a textbook case for a social-ecological system rapidly approaching a resilience collapse. Scientists have a key responsibility to illuminate this danger for the society.

Vilda predatorer men tama bytesdjur – konsekvenser av stora rovdjur på rennäring

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De vilda stora rovdjuren i norra Fennoskandien har tamdjur som sin främsta kalkylerade födoresurs, varav tamrenarna svarar för huvudparten. I synnerhet för svenskt vidkommande är rovdjuren det enskilt största akuta hotet mot rennäringen och drabbar näringen på flera plan. Rennäringens situation i relation till rovdjuren är lite uppmärksammad såväl forskningsmässigt som i förvaltningssammanhang. En skattning av predationens omfattning enligt en försiktighetsprincip med utgångspunkt i renskötseln tyder på predationsnivåer på mellan 45 000 och 50 000 renar i Sverige, ca 20 000 i Norge och ca 10 000 i Finland. Detta motsvarar ca 20% av vinterstammen under senaste åren i Sverige, 8% i Norge och 5% i Finland.
Skillnaderna mellan att basera rovdjurspolitiken på tama i stället för vilda bytesdjurspopulationer är fundamental. Tamdjur inklusive renar är naiva byten p.g.a. domesticeringen och därmed mer utsatta för rovdjursangrepp än vilda bytesdjur. De ingår dessutom i optimerade produktionssystem med viktiga ekonomiska, sociala och kulturella roller i mänskliga system. I en väl fungerande renskötsel är produktionskonsekvenserna i form av minskad slakt ca 1,7 ggr större än själva predationen p.g.a. dynamiska effekter i en optimerad renhjord, och ytterligare större om även nutritionella effekter med försämrad kondition och produktion som följd och minskat urvals- och gallringsutrymme beaktas. Utöver de direkta och dynamiska förlusterna i renhjorden gör rovdjursnärvaron också utnyttjandet och förvaltningen av tillgängliga betesresurser mindre effektiv. Driftsmässigt leder rovdjursnärvaro till försämrad kontroll över djurens betesgång, minskad förutsägbarhet, ökade obetalda arbetsinsatser och driftskostnader och svårigheter att hantera djuren.
Ekonomiskt drabbas renskötseln mycket hårt genom den inneboende låga omsättningen och begränsade ekonomiska marginalerna, liknande det som är typiskt för ”vilda” system. Den lägre produktionsvolymen leder också till ett sämre marknadsläge genom lägre utbud och ger samtidigt mindre intjäning och lägre sysselsättning i förädlingsledet.
De sociala konsekvenserna är betydande till följd av traumatiska upplevelser vid möten med dödade, skadade och lemlästade djur, starka känslor av otrygghet, olust, misstroende och vanmakt, liksom ökade konflikter med omvärlden. En ytterst allvarlig konsekvens av påfrestningarna är de påtagliga bevisen på ökad mental ohälsa under senare år i synnerhet bland unga människor i renskötarleden. De sannolika långsiktiga konsekvenserna av denna situation är att renskötaryrket blir mindre attraktivt och näringen får svårigheter vid generationsväxlingar och nyrekrytering av unga till näringen.
Nuvarande rovdjurssitution särskilt i Sverige, tillsammans med alla övriga svårigheter rennäringen möter i dag, framstår som ett skolexempel på ett socialt-ekologiskt system som snabbt närmar sig ett resilienssammanbrott. Forskningen har en nyckelroll när det gäller att tydliggöra situationens allvar för omvärlden.

Economic consequences of the large predators for the reindeer industry in Sweden

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Based on a precautionary projection of the depredation pressure on reindeer husbandry in Sweden (47 500 killed reindeer/year: Danell & Danell, this conference), the consequences for the productivity and the economy of the reindeer industry were projected with different harvest strategies, herd compositions and numbers of reindeer in winter stock. Three harvest strategies were used: a maximised calf harvest strategy (K), a combined calf and adult male harvest strategy (KS), and a harvest strategy without selection on animal type (U). In the K strategy, which aims at maximising the productivity per head in the winter stock, the proportion of females was set to 0.9. In the KS strategy, which gave opportunities for production of adult males for slaughter while maximising calf slaughter on the female side, the proportion of females was 0.65. The same female proportion was used in the U strategy, which has similarities with traditional harvesting strategies.
The three strategies were compared at three population sizes: the recent approx. 260 000 reindeer in winter stock, the long term mean of 225 000 reindeer, and 200 000 reindeer under which the reindeer number periodically has gone. Economic assessments in the husbandry section were based on 40 SEK/kg carcass (currently 55 SEK/kg) plus official subsidies of 14 and 8.50 SEK/kg calf and adult carcasses, respectively, the current 56 MSEK in predator compensation, and 346 SEK/reindeer in running expenses in all alternatives (although likely lower without predators than with predators). The market price of reindeer meat products was set to 90 SEK/kg processed carcasses in alternatives without depredation, and 80 SEK/kg in alternatives with depredation (currently both likely 15 SEK higher). The running costs excluding labour were set to 10 SEK/kg processed carcasses.
Without depredation the three harvest strategies K, KS, and U resulted in 3744 to 3242, 3169 to 2717 and 2763 to 2410 tons of processed carcasses, respectively, in the range from 260 000 to 200 000 reindeer. Using the mean carcass price, the economic results in the production sector were projected to between106 and 101 MSEK with the K strategy, and near 70% and 50% of this with the KS and U strategies, respectively. Using the mean carcass and market prices, the results in the processing industry were projected to between 150 and 130 MSEK with the K strategy and 84% and 75% of that with the two other harvest strategies, respectively. In total without predation, the results in the reindeer industry amounted to 256 to 231 MSEK in the K strategy, and 78% to 61% of that with the KS and U strategies.
The depredation reduced the carcass production with 52% to 63% with the K strategy. The economic results in the production part (incl. 56 MSEK in predator compensations) decreased to between 60 and 43 MSEK (-43% to -52%) and between 54 and 36 MSEK in the processing industry (-64% to -72 %). The reductions with the KS and U strategies were slightly lower in relative terms, due to the lower productivity of these strategies.
With the KS and U strategies the reindeer stock was near collapse with 225 000 reindeer in winter stock, shown by a very low surplus of female calves. They collapsed at 219 000 and 207 000 reindeer, respectively. With the K strategy, the collapse appeared at slightly more than 190 000 reindeer.
The conclusion is that the reindeer industry is very close to a collapse both biologically and economically with the current depredation pressure. Collapses are locally at risk already with the depredation level projected here at occasional decreases of reindeer numbers (unfavourable years, enterprises becoming bankrupt, etc.) and/or continued increase of the depredation pressure. Since local collapses decrease the number of reindeer, they may rapidly propagate. The current Swedish predator policy is, without any doubts, an extremely serious threat for the reindeer industry.

Ekonomiska konsekvenser av de stora rovdjuren för rennäringen i Sverige

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Baserat på en skattning av nuvarande predationstryck på rennäringen i Sverige utifrån en försiktighetsprincip sett ur bytespopulationens synpunkt (47 500 renar/år: Danell & Danell, denna konferens) beräknades produktionsmässiga och ekonomiska konsekvenser i rennäringen vid olika slaktstrategier, hjordstrukturer och renantal i vinterstammen. Slaktstrategierna var maximerad kalvslakt (K), ett kombinerat kalv- och sarvslaktalternativ (KS) och ett slaktalternativ utan selektion på djurtyp i slaktuttaget (U). I K-strategin, som maximerade produktiviteten per ren i vinterhjorden, var hondjursandelen i vinterhjorden 90%. I KS-strategin, som gav utrymme för produktion av sarvar till slakt jämsides med en maximal kalvslakt på hondjursidan, och i U-strategin, som har viss likhet med traditionella slaktuttagsformer, var hondjursandelen 65%.
Alternativen jämfördes på tre olika djurantalsnivåer: de senste årens ca 260 000 renar i vinterstam, långtidsmedelvärdet 225 000 renar samt nivån 200 000 renar som periodvis har understigits. Ekonomiska kalkyler i produktionsledet baserades på medelpriset 40 SEK/kg slaktkropp (aktuellt pris är 55 SEK/kg) plus statliga pristillägg om 14 och 8,50 SEK/kg slaktkropp för kalvar resp. vuxna, nuvarande rovdjursersättning om totalt 56 MSEK/år, samt 346 SEK i driftskostnad per ren (i verkligheten troligen lägre utan rovdjur än med rovdjur). I förädlingsledet användes medelpriset 90 SEK/kg förädlad slaktkropp i alternativ utan predation och 80 SEK/kg vid predation (aktuella priser torde vara ca 15 SEK/kg högre), samt produktionskostnader exkl. arbete om 10 SEK/kg förädlad slaktkropp.
Utan predation resulterade de tre uttagsstrategierna K, KS och U i mellan 3744 och 3242, 3169 och 2717 resp. 2763 och 2410 ton slaktkropp i spannet från 260 000 till 200 000 renar. Resultaten i produktionsledet baserat på medelpriset beräknades ligga mellan 106 och 101 MSEK i K-strategin och nära 70% resp. nära 50% av detta i KS- och U-strategierna. I förädlingsledet blev resultaten 150 till 130 MSEK i K-strategin och 84% resp. 74% av detta i de två andra slaktstrategierna. Sammantaget för branschen blev de potentiella resultaten mellan 256 och 231 MSEK i K-strategin och mellan 78% och 61% av detta för KS- och U-strategierna.
Predationen (47 500 dödade renar) reducerade den producerade mängden slaktkropp med 52% till 63% i K-strategin. De ekonomiska resultaten (inkl. rovdjursersättningar) minskade i produktionsledet till mellan 60 och 43 MSEK och i förädlingsledet till mellan 54 och 36 MSEK. Sammantaget minskade resultatet i branschen således till mellan 115 och 84 MSEK. I KS- och U-strategierna var sänkningarna relativt sett något mindre beroende på att produktionsformerna i sig var mindre produktiva.
KS- och U-strategier låg dock nära kollaps vid 225 000 renar till följd av predationen, vilket framgick av mycket låga överskott av honkalvar till slakt. De kollapsade vid 219 000 resp. 207 000 renar då predationen svarade mot 22% resp. 23% av vinterstammen.. I K-strategin var brytpunkten för kollaps strax över 190 000 renar då predation utgjorde 24,6% av vinterstammen.
Slutsatsen är att situationen i rennäringen är ytterst nära kollaps både biologiskt och ekonomiskt vid nuvarande rovdjurstryck. Kollapser riskerar att utlösas lokalt redan vid det predationstryck som förutsatts gälla här i samband med nedgångar i renantal (dåliga år, konkurser e.d.) och/eller vid fortsatt ökning av predationstrycket. Eftersom lokala kollapser sänker renantalet ytterligare kan de snabbt sprida sig. Tveklöst är den nuvarande rovdjurspolitiken ett ytterst allvarligt hot för rennäringen.

Females' spatial organization during rut

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Considering the economical importance of reindeer herding and maximizing meat production, emphasis should be put on an appropriate herd structure. Manipulations of population size, sex ratio and age structure may influence females' distribution and social organization during rut and the degree of polygyny. Matrilineal organization, as seen in many gregarious ungulates, may increase the chance that closely related females being fertilized by the same male and increase the herd's inbreeding vulnerability. Given no active inbreeding avoidance mechanisms in reindeer this may induce reduced genetic heterogeneity and fitness of animals. Furthermore, the availability of males may affect the reindeer females' association and distribution during the rut: the presence of prime-aged males may lead to females being less dispersed; less harassed by younger males and hence might increase the probability of more synchronous rut. This, in turn, may influence the pregnancy rates and calving dates. The aim of this study was to determine if reindeer females are organized in matrilines during rut and the effects of male age on these bonds. Further, we examined if female age as well as the phenology of the rut influenced the females' association.

The study was conducted at the Kutuharju Field Reindeer Research Station, in Kamaanen, Northern Finland. During the rutting season the composition of the male segment of herds was manipulated with three 4.5 year old male in 1999, and 3 1.5 year old males in 2000; the female segment, with known pedigree, was kept similar between treatments (1999: 75 females; 2000: 74). The males were radio collared. During the rut (from the 25th September to the end of October) the males were located daily and the females' associated with them recorded. The association index was calculated based on the frequency with which each dyad was observed within the same groups. We used GENMOD procedure to asses the effects of matriline and treatment on association.

The association between female reindeer during rut was higher among closely related individuals (mothers and daughters, half sisters, aunt / niece and grandmother / granddaughter) as compared to non-related individuals, indicating the existence of matriline organization in reindeer. Further, the association was higher when exposed to three young males as compared to three adult males and in post rut than in pre-, and toprut. Among the closely related individuals the mother-daughter associated more than the other related individuals. Neither effect of phenology of the rut nor effect of male segment was found. Among mother-daughter relationships there was no effect of age on the association and these bonds didn't weaken with time. The size of the mating groups varied throughout the rut, being highest in the toprut in 1999 and postrut during 2000. There was no significant difference in group size during rut between the two years.

The effect of matriline, being highest among mother-daughter, does not necessarily pose inbreeding problems since matriline females are moving between groups and will be exposed to different males at the time of oestrus. This was confirmed by the fact that only a few mothers and daughters were sired by the same male.

Simlenes organisering og romlige fordeling under brunst

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Flokkstrukturen er avgjørende for økonomien i reindrifta. Samtidig vil flokkens størrelse, dens kjønns- og alderssammensetning påvirke simlenes fordeling og organisering under brunsten og bukkenes reproduktive suksess. Hos mange flokklevende klauvdyr er hunndyrene organisert langs morslinjer. Dersom dette er tilfelle også hos rein, vil sjansen øke for at nært beslekta simler bedekkes av samme bukk og kan gjøre flokken sårbar for innavl. Det er ikke observert aktive mekanismer for å unngå innavl hos rein – dette vil forsterke muligheten for reduksjon i genetiske variasjon og redusert "fitness". Videre vil tilgjengeligheten av bukker under brusten kunne påvirke simlenes organisering og fordeling: er det mange storbukker i flokken, kan dette føre til at simlene holder seg mer samla og blir mindre forstyrra av småbukker. Dette kan øke sjansen for en synkron kalving, en høgere drektighetsprosent og påvirke kalvingstidspunktet.

Målet med studiet var å bestemme om simlene er organisert langs morslinjer under brunsten og om bukkenes alder påvirker denne organiseringen. Videre undersøkte vi om simlenes alder og brunstperiode (før-, topp- og etterbrunst) påvirker organiseringen. Studiet ble gjennomført i Paliskuntain yhdistys sin forsøksflokk i Kutuharju, Kaamanen, Finland. Vi manipulerte med sammensetningen av bukkesegmentet under brunsten i 1999 (tre storbukker; 4,5 år) og i 2000 (tre småbukker; 1,5 år), mens tallet på simler (med kjent avstamning) ble holdt konstant; henholdsvis 75 og 74. Bukkene ble market med radiosendere. Under brunsten ble disse lokalisert daglig og simlene rundt dem identifisert. En assosiasjonsindeks for hvert simle-simle par ble kalkulert basert på antall ganger de var observert sammen og hver for seg. Vi brukte GENMOD prosedyren i SAS for å undersøke slektskap langs morslinjer og om alder på bukkene påvirket assosiasjonsindeksen mellom simlene.

Assosiasjonen var høyere mellom nært beslekta simler (mødre-døtre, halvsøstre, tanter-nieser og bestemødre-døtredøtre) sammenlignet med mindre beslekta simlepar, noe som tyder på at simlene er delvis organisert langs morslinjer. Videre var assosiasjonsindeksen blant simler generelt høyere ved eksponering til bare småbukker under brunsten sammenlignet med bare storbukker og under etterbrusten sammenlignet med under før- og toppbrusten. Blant nært beslekta simlepar var det ingen effekt av brunstperiode eller alder på bukkene. Mødre-døtre hadde en høyere assosiasjonsindeks sammenlignet med andre nært beslekta simlepar. Blant mødre-døtre parene var det ingen effekt av mødrenes alder, og båndet mellom dem svekket seg ikke over tid. Størrelsen på haremsgruppene varierte gjennom brunsten og var størst under toppbrunsten i 1999 og under etterbrunsten i 2000. Det var ingen forskjell i haremstørrelse mellom de to bukkesegmentene (storbukk *vs*. småbukk).

Effekten av morslinjer, mest markert blant mødre-døtre, trenger ikke nødvendigvis å føre til innavl siden simlene beveger seg mellom haremsgrupper kontrollert av ulike bukker under brunst og er derfor eksponert til ulike bukker under eggløsningen. Dette bekreftes også av at få mødre-døtre par ble bedekka av samme bukk.

Do windmill parks affect the range use of free ranging semi-domestic reindeer?

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Nowadays, there is a rapid increase in the development of large scale wind power plants in Scandinavia. Construction of a wind power plant area entails a relatively wide spread infrastructure of internal roads, buildings and high towers with continuously moving parts visible and audible from distances of many kilometres. Reindeer move over large areas for grazing, and usually with seasonal shifts. Between season and large scale range use, semi-domestic reindeer is, in a practical manner, most often controlled by their respective herdsmen. However, within season and small scale to medium areas (1 km^2 to 50+ km^2), range use is less influenced by herdsmen and mostly controlled by a number of environmental variables such as pasture properties, weather, and harassment by parasitic insects, etc. Small to medium scale range use can be negatively influenced by disturbances leading to avoidance or aversion towards anthropogenic infrastructure such as windmills and other human constructions and activities. The aversion and/or avoidance of certain pastures can lead to less optimal range use, overgrazing, complications with herding, increased costs and reduced production. Habituation is also possible, and varying degrees of avoidance and habituation may change over time.
We tested the effect of the Kjøllefjord wind power plant, opened in 2006 on the Dyfjord peninsula in Finnmark county, on reindeers' area use. The study aimed at testing area use while reindeer were on their summer range and at the small to medium geographical scale of approximately 1 km^2 to 50 km^2. Reindeer positions in the study area were registered through direct observations. Additional variables were year, within season periods (post calving, summer, and autumn), group size, behaviour of individuals in a group, vegetation type and per cent cover, weather and herding activities. Fieldwork was conducted over approximately one week once a month from late May and until September/ October from September 2005 to September 2008. The study area composed of the Dyfjord peninsula (the wind power plant test area) and three control areas also within the herd's summer range; Skjøtningberg peninsula (since September 2005), Blåfjell (since summer 2006), and the area west of highway 888 and north of highway 894 (since summer 2007). The reindeer positions were imported to ArcGIS for precise calculations of elevation, vegetation types and distance to human infrastructure. To compliment the reindeer position data, we also conducted faeces counts at the end of each season along transects throughout the study area. We assumed that the distribution and total number of faeces sampled in the study area represented a reliable, relative measure of the number of individual reindeer in each area in total for the entire season for each year. The area within and surrounding the windmill park was used by reindeer in all years.
According to the faeces counts, more reindeer used the test area in the following years (2006, 2007, and 2008) after construction of the windmill park compared to the year construction began (autumn 2005). Also, according to directs observations, the wind power plant test area (Dyfjord peninsula) was used equally or more by reindeers within years compared to the control areas. In the summer of 2008, the internal road was used considerably by reindeer, especially during days with insect harassment. Detailed analyses are underway, but there are presently few indications of strong avoidance or aversion towards the Kjøllefjord wind power plant, the Dyfjord peninsula by reindeer at the scale of our study. At a larger scale encompassing the entire summer range of this herd, herding activities, fencing, round-ups, spring arrival and autumn departure from the area were clearly overriding factors for the reindeers' range use.

Påvirker vindmølleparker tamreinens områdebruk?

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Det er i dag en rask økning i utviklingen av vindmølleparker i Skandinavia. Utbygging av områder med vindmøller medfører relativt mye infrastruktur, så som veier og bygninger, og vindmøllene selv er høye med bevegelige deler med en diameter på flere titalls meter. Disse synes og høres ofte på flere kilometers avstand. Reinsdyrenes naturlige atferd er migratorisk, de forflytter seg over store områder for å finne beite, og dette styres av blant annet sesongvariasjoner. For tamrein er mellom-sesong-trekk og storskalabruk av områder i dag i praksis styrt av reineierne. Imidlertid er områdebruk innen sesongen og for liten til middels skala (1 km^2 til 50+ km^2) mindre påvirket av reineieren og styres i hovedsak av flere miljøfaktorer. Dette kan være beitekvalitet, værforhold, insektsforstyrrelse etc. Liten til middels skalaområdebruk kan bli negativt påvirket av forstyrrelser, noe som kan medføre unngåelse av områder med infrastruktur og menneskelig ferdsel. Unngåelse av visse beiteområder kan gi mindre optimal områdebruk, med overbeite, problemer for reineierenes driving av flokkene, økte økonomiske og energetiske kostnader og redusert produksjon som negative konsekvenser. Det kan også tenkes at dyrene over tid vil vise en viss tilvenning til vindmølleparken og graden av unngåelse og tilvenning kan variere over tid.

Vi har her testet effekten av Kjøllefjord vindmøllepark,(Dyfjordhalvøya, Finnmark, åpnet i 2006) på tamreins områdebruk. Siden storskala og mellom-sesong-trekk områdebruk styres av reineierne, konsentrerte vi vår studie på test av områdebruk på sommerbeitet og på en liten til medium geografisk skala (ca 1 km^2 til 50 km^2). Ved direkte observasjon ute i felt ble reinens posisjoner kartlagt. Variabler som år, innen-sesong-perioder (”etter kalving”, ”sommer” og ”høst”), gruppestørrelse, atferd hos gruppens individer, vegetasjonstype og -dekke, vær og gjetingsaktivitet inngikk også i registreringen. Feltstudiet ble gjennomført i en uke en gang per måned fra mai til september/oktober hvert år, med første feltperiode september 2005 og siste feltperiode september 2008. Studieområdet besto av Dyfjordhalvøya, hvor vindmølleparken er lokalisert, og tre kontrollområder; Skjøtningberhalvøya, Blåfjell og området vest for riksvei 888 og nord for riksvei 894. Registrerte posisjoner for reinsdyr ble importert til ArcMap 9.2 og analysert for høyde over havet, vegetasjonstyper og avstand til infrastruktur. Som støtte til direkte observasjoner av reinsdyr ble det gjort feaces-tellinger ved slutten av hver feltsesong langs transekter gjennom studieområdene. Vi antok at fordeling og summen av registrert faeces i studieområdet ga et representativt, relativt mål på totalt antall rein som hadde brukt hvert studieområde hele sesongen for hvert enkelt år. Området i og rundt vindmølleparken ble brukt av reinsdyr hvert år.

Faeces tellingene viste at flere reinsdyr brukte områdene i årene etter at bygging av vindmølleparken var startet (2006, 2007 og 2008) enn i det året anleggsvirksomheten startet opp (2005). I tillegg har de direkte observasjonene vist at testområdet (Dyfjordhalvøya) totalt sett har blitt like mye eller mer brukt innenfor de enkelte år sammenlignet med kontrollområdene. Sommeren 2008 viste det seg at veiene i vindmølleområdet ble hyppig brukt av reinsdyr, særlig på dager med store insektsplager. Mer detaljerte analyser kommer, men vi ser ut fra foreløpige analyser få indikasjoner på unnvikelseseffekter fra Kjøllefjord vindmøllepark eller nærliggende områder for reinsdyrene med den skala vår studie hadde. På en større skala hvor hele sommerbeitet til reinflokken inngikk var variabler som drivinger, inngjerding, tidspunkt for ankomst til sommerbeite og flytting fra sommerbeite de styrende faktorer for reinenes områdebruk.

Evaluation of preventive efforts against loss of reindeer to predators in Norway

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During the period 2003-2007, between 25% and 37% (28 000 to 51 000 no. of calves) of the reindeer calves have been reported lost from spring to autumn in Norway. The most important factors were carnivore depredation, illness and nourishment failure. The reindeer herders report that protected carnivores caused the loss of about 75% to 90% of the total loss of calves. In Norway, the County Governors have financed the following preventive measures:
-Extraordinary supervision during the calving season. -Fences/intensive herding in other periods than the calving season. -Supplementary feeding. -Extraordinary moving/transportation of the reindeer heard. The County Governors have also granted financing for measures directed toward carnivores (Permitted hunting on harmful individuals, guidance in how to hunt for carnivores, registration of populations, bounty for registration of younglings). These measures can reduce the losses as well as the conflicts:
Through surveys, meetings, in depth interviews, and the applications and reports on preventive measures from the different reindeer herding *siidas* (herding groups) in Norway during the period 1990-2006, broad information have been gathered. The preventive measures are evaluated on their effectiveness regarding protection towards carnivores, animal welfare and resources required. However, one also has to take into account the strong tradition reindeer herding has within the Sami culture.
Suggestions directed toward the reindeer herding are: -Preventive measures distributed throughout the whole of the year. -Economic compensation for reduced breeding abilities. -Guidance in supplementary feeding. -Better search for carcasses. -Use of GPS tracking device to enhance the supervision. -Adjusted reindeer stock to the grazing area.
Suggestions directed toward research and management are: -Cooperation across borders between Norwegian counties and the Nordic countries. -Extended period of application for economical compensation of losses due to carnivore depredation. -Simplified application process and more effective application management. -Enhanced registration of populations. -Enhanced quality of projects and preventive measures, and use of the competence from the reindeer herders.
Suggestions directed toward carnivores are: -Decreasing the carnivore population and prioritized hunting of especially harmful individuals. -An even distribution of carnivores within the managed areas/a removal of the zone system. -Calving areas free form carnivores.

Conclusion: The most used measure is extraordinary supervision during the calving season. However, according to the herders this measure is the easiest to get financed, and therefore perceived as the only real possibility. The herders mostly coincide in that the only effective measure is to achieve better control of the carnivores, in addition to fewer carnivores within the reindeer grazing areas. The herders have many suggestions for changes. Many of them deal with a structural change within the application system. The herders also have some suggestions for changes that include a higher quality in research and management. In conclusion, the herders evaluate several of the preventive measures as partly effective in different regions. However, there is a need for more flexibility within the application period and the prioritized measures. Many herders do not use the system of financed preventive measures because of the time-consuming application process, in addition to the strict prioritizing of measures that do not fit their needs. For this reason, they request that the management look at the year as a whole when deciding on which measures to finance.

Evaluering av forebyggende tiltak mot tap av rein til rovvilt i Norge

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I perioden 2003-2007 ble 25% til 37% (28 000 til 51 000) av reinkalvene i Norge tapt fra våren og fram til høsten. De viktigste tapsårsaker hos rein var rovvilt, sykdom og ernæringssvikt. Reindrifta angir at fredet rovvilt er årsak til 75% til 90% av kalvetapene. I Norge har Fylkesmannen (Länsstyrelsen) finansiert følgende tiltak rettet mot reindrifta: -Ekstraordinært tilsyn i kalvingsperioden/ kalving i gjerde. -Gjerder/intensiv gjeting utenom kalvingsperioden. -Tilleggsfôring. -Ekstraordinær flytting.
Opplysninger fra reindriftsutøverne om deres erfaringer med forebyggende tiltak mot rovviltskader på rein er innhentet gjennom en skriftlig spørreundersøkelse, møter, dybdeintervju og en gjennomgang av søknader og rapporter fra de ulike reinbeitedistriktene i Norge som har mottatt tilskudd fra Fylkesmannen i perioden 1990 til 2006). I tillegg er brukernes egne forslag til endringer i forvaltning og forebyggende tiltak registrert. Foruten tiltakene direkte rettet mot reindrift, har Fylkesmannen bevilget midler til tiltak rettet mot rovdyr (skadefellingstillatelser, jaktkurs/veiledning, bestandsregistrering, dusør for innmelding av nye ynglinger og hekkeområder). Disse tiltakene kan både ha en tapsreduserende og en konfliktdempende effekt.
Reindriftsnæringen har utpekt viktige prioriteringsområder i den videre forvaltningen. Forslag rettet mot rein og driftsform er: -Forebyggende tiltak fordelt over hele driftsåret. -Økonomisk kompensasjon for redusert avlsmessig framgang. -Kompetanseheving rundt tilleggsfôring av rein. -Bedre kadaversøk.- Bedre oversikt og raskere tilsyn ved bruk av radiobjeller. -Reintall tilpasset til beitegrunnlaget.
Forslag rettet mot forskning og forvaltning er: -Grensekryssende samarbeid. -Utvidet søknadsperiode for midler til forebyggende tiltak. -Forenkle søknadsprosessen og raskere behandling av søknader. -Bedre bestandsovervåking og økt bemanning. -Benytte reindriftas kompetanse i utarbeiding av forebyggende tiltak.
Forslag rettet mot rovvilt er: -Redusere antallet rovdyr og et rettet uttak av skadegjørende individ. -Jevnere fordeling av rovdyr innenfor forvaltningsområdet og utvisking av rovdyrsoner. -Rovviltfrie kalvingsområder

Konklusjoner: Ekstraordinært tilsyn i kalvingsperioden det mest brukte tiltaket. I samtale med brukerne selv er imidlertid dette tiltaket det som er lettest å få midler til. Å sikre økt overlevelse av reinkalvene er viktig for å sikre næringa i et langsiktig perspektiv. Næringa selv er i stor grad samlet om at det eneste tiltaket som fungerer er en bedre kontroll på og reduserte rovviltbestander i beiteområdene. Det er et klart behov for mer fleksibilitet innen søknadsperioden og prioriterte tiltak. Det er ønskelig at forvaltningen må ha et mer helhetlig blikk på reindriftsåret når de avgjør hva slags tiltak som skal gis tilsagn.

Nutritional mapping of grazing areas using nutrient and fiber profiles of reindeer forage plants of the Seward Peninsula, Alaska

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Reindeer producers on the Seward Peninsula, Alaska must place animals in areas of high quality forage during spring and summer to maximize growth rates and herd production.
Regression models were developed using Julian date (JD), growing-degree-days (GDD) and phenology (PH) to predict concentrations of nitrogen (N), phosphorus (P), potassium (K), neutral detergent fiber (NDF), acid detergent fiber (ADF) and in-vitro true dry matter digestibility (IVTDMD) of forage plants throughout the growing season found on reindeer ranges of the Seward Peninsula.
Mineral and fiber concentrations and digestibility differed greatly across plant growth forms, but were similar among members of the same genus. N, P and K concentrations were very high in emerging leaves of willow and forbs and declined at a fluctuating rate through the growing season. Concentrations of nitrogen and minerals, and digestibility of leaves of graminoids and digestibility of willow leaves increased during spring to early summer when they began to decrease. NDF and ADF concentrations in graminoids were at a minimum during midseason, in contrast to deciduous shrubs that exhibited low fiber concentrations in the spring with progressive increases through midseason to senescence. Fiber concentrations in forbs were lower and fluctuated less dramatically than either graminoids or shrubs. Digestibility of willows and graminoids was less than forbs.
These data were coupled with existing forage production data to predict the net nutrient pool of all reindeer forage plants within a habitat (ecological site). A computer program and interactive website was developed capable of generating a daily nutritional map reflecting forage quality across the landscape to guide placement of reindeer on large, diverse ranges. Julian date was used as a general predictor of plant chemistry and indicator for reindeer placement, whereas the relationship between GDD and plant chemistry was used to refine animal location based on the unique thermal characteristics of specific sites. A reindeer producer can also use the stage of growth (PH) to evaluate the real time, nutritional status of forage across his range.

Contrasting reindeer management regimes in Fennoscandia and Nenets regions of Russia: Implications for adaptation to climate and land use change

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The most productive semi-domestic reindeer breeding systems in Eurasia are those based in Fennoscandia and the Nenets regions of northern Russia, which straddle the Ural Mountains. The management regimes in these regions share some commonalities, such as their general adherence to carrying capacity models. Yet they also present stark contrasts. The modern Fennoscandian system is characterized by motorized extensive herding practiced within much shorter annual migrations and territories, which are often divided and subdivided by fences, with a diversity of terrain not found in the Nenets regions. The latter are represented by flat to slightly rolling landscapes void of fences where close herding with humans and dogs is practiced along migrations routes of up to 1200 km. Climate change ranks high among the concerns of in Fennoscandian scientists and herders. Despite the absence of supplemental feeding to buffer against extreme snow and ice conditions, Nenets view oil and gas development and rights to land as much graver and more immediate threats than what they perceive as examples of 'extreme weather'. Both regions experience to some extent a disconnect between the state institutions charged with overseeing management, other encroaching land users, and the actual day to day needs of herders. The differences between these two systems are discussed with regard to the implications for long-term resilience in the face of ongoing climate and land use change.

The dispute about the legislation concerning reindeer herding in Norway and Sweden

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The paper will present the arguments in the dispute about new legislation concerning the reindeer herding in Norway and Sweden from mid 1990s to the final political decision making in the years 2005 to 2007. It is based on a project with a theoretical basis in institutional theory within the academic fields of political science and sociology, sociology of knowledge as well as discourse analysis. The focus is on discourses of meaning and reality construction and studies of institutional processes and institutional change.
We have identified (a) ”established” discourses about reindeer herding, management of reindeer herding and Sami questions in Norway and Sweden in the period before 1990. These discourses contain arguments about conflicts between reindeer herding and agriculture and forestry about the use of the land. Another established discourse is whether reindeer herding should be considered as a modern economic activity or as a pillar in the Sami culture. Further (b) the “new” discourses from 1990 on, are the discourses of sustainable development, public management and finally the international discourse about the rights of indigenous peoples’ rights. We ask what type of discourses are the dominant in the political debate from the 1990s to 2007. Moreover, we inquire what type of relations we can find between arguments and interests of the actors. This includes both actors from reindeer herding groups, agriculture groups and from different parts of public administration.
We find that the debate in Sweden is more relentless than in Norway and also charecterised by less accepatance of the arguments of the counterpart.The different actors have both different interpretations of both rights and of courts decisions especially the decisions of the supreme court in the Tax Mountain Case (Skattefjällsmålet). In particular, this concerns questions of rights where not only positions are different, but also the interpretations of legislation and legal documents.
In Norway the organisation of the public reindeer administration has been debated. Based on the argumenst used we find that in Norway the siida institution have been associated with: the purpose of increased legal protection for reindeer herding, as a revitalisation of a traditional Sami institution, and as a possible instrument for more efficient government. Generally, the argumentation is dominated by two types of logics: a logic referring to rights of land-use and a functional logic. Each of the logics can be related to different types of knowledge and practices developed by different professions in different social and political contexts. The connection between these logics are very much not discussed within any of the two countries. Thereby, the unclear discussion of the interelation of the logics are not persist both in the reports and the disputes related to them.

The presentation is based on a report in press to be published by Department of Economics and Resource Management, Norwegian University of Life Sciences. The report will be in Norwegian but with a summary in North-Sami, Swedish and English.

Argumentasjonen omkring endringer av reindriftslovene i Norge og Sverige

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Foredraget vil presentere argumentasjon fra ulike aktører som var aktive i debatten om utredningene om reindriften, om endringer i lovverket for reindriften og reindriftsforvaltningen, i Norge og Sverige fra slutten av 1990-tallet og fram til den endelige politiske behandlingen i årene 2005-2007. For Norges del dreier dette seg om endringen av reindriftsloven i 1996, Reindriftslovsutvalgets rapport, høringsuttalelser til rapporten, den politiske behandlingen av denne rapporten i Stortinget i 2005 og 2007, Riksrevisjonens rapport om reindriften i Finnmark, saken om Finnmarksloven samt Sameretts-utvalget. For Sveriges del har prosjektet konsentret seg om diskurser i sammenheng med tre utredninger: SOU:1999 nr. 25 ”Samerna – ett ursprungsfolk i Sverige. Frågan om Sveriges anslutning till ILOs konvention nr. 169”, SOU:2001:1001, Gränsdragningskommisionen, samt utredningen om jakt og fiske.
Prosjektet anvender institusjonell teori innen statsvitenskap, sosiologi og kunnskapssosiologi, med fokus på diskurser, menings- og virkelighetskonstruksjon samt studier av institusjonelle prosesser og institusjonell endring. Prosjektet har identifisert a) ”etablerte” diskurser om reindrift, reindrifts-forvaltning og samiske spørsmål i Norge og Sverige i perioden før 1990. Dette dreier seg om hvordan saksforhold og argumenter knyttes til konflikter mellom reindrift, landbruk og skogbruk om bruken av arealer og spørsmålet om reindrift som moderne næring eller som samisk kulturbærer. Prosjektet har videre b) studert i hvilken grad de ”etablerte” eller ”nyere” diskurser fra 1990-tallet slik som bære-kraftig utvikling, public management og urfolks rettigheter dominerer i utredningene og debattene i forbindelse med disse utredningene fra 1990-tallet og fram til 2007.
Vi har søkt etter sammenhenger mellom standpunkter, argumentasjon og interesser som aktørene har. Dette gjelder både næringsinteresser og posisjoner knyttet til tilhøringet til ulike typer forvaltning. Vi har spurt hvordan aktørene forholder seg til ulike typer saksforhold og argumenter og videre hvordan disse blir elementene knyttet sammen, eller ikke knyttet sammen, i de uttalelsene som kommer.
Vi har funnet at debatten er mer uforsonlig og mer preget av at en ikke aksepterer motpartens argumenter i Sverige enn i Norge. Dette gjelder særlig spørsmålet om rettigheter der en ikke bare har helt ulike ståsted, men hvor en også har helt ulike fortolkninger av både lovgivning og rettsdokumenter. I Norge er det også uklarhet omkring sentrale spørsmål knyttet til organiseringen av reindriften. Ut fra de argumentene som framkom i debatten i Norge ser vi at for eksempel siida- institusjonen både blir assosiert med større rettsikkerhet for reindriften, et uttrykk for en revitalisering av en samisk institusjon og som et mulig instrument for en mer effektiv styring fra de statlige myndigheter. Generelt preges argumentasjonen av to typer logikker, en rettighetslogikk og en funksjonalitetslogikk som hver for seg knyttes til ulike typer kunnskap og praksis som igjen utvikles av ulike faggrupper i ulike kontekster. Sammenhengen mellom disse logikkene er lite diskutert og dermed lite klargjort både i utredningene og i debatten i forbindelse med dem.

Innlegget bygger på et arbeid som er under utgivelse: Gundersen, Frode & Jan Åge Riseth. Diskurser om utviklingen av reindriften og reindriftsforvaltningen i Norge og Sverige. En studie av argumentasjonen om reindriften og reindriftsforvaltningen i Norge og Sverige. Institutt for Økonomi og ressursforvaltning. Universitetet for miljø og biovitenskap.Ås, Norge.

The reindeer industry at a climate turning point?

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The reindeer industry has so far been well suited to cope with the ongoing climate changes, but has to be prepared for larger adaptations in the future. This is the main conclusions from the project ”Effects in Sapmi”, which have studied the climate change effects the last 50 to 100 years, as well as future consequences for the reindeer industry in Norway. ”Effects in Sapmi” was part of the research project ”PhenoClim” (Phenology as an indicator of climate change effects), funded by the Norwegian Research Council for the period 2003 to 2008.
The project ”Effects in Sapmi”, which mainly addressed the winter season, is based on meteorological data, written sources from the reindeer management body and others during 50 years, interviews with experienced reindeer herders and managers, future climate scenarios, as well as other research in this field, especially from other parts of the “PhenoClim” project.
Increasing temperatures and extended growing season have so far had minor effects on the reindeer management land use patterns. Changes over time in Finnmark are mainly an effect of adaptations to other reindeer management groups. In Nordland and Nord-Trøndelag changes are mainly caused by land interventions and other land use interests.
The reindeer industry have always coped with and adapted to changing weather and pasture conditions from year to year. Some extremely hot and cold summers, and blocked access to pastures some winter seasons, have caused serious problems, but this has mainly been a consequence of high reindeer densities.
Increased temperatures of 2 to 4 degrees the next 100 years, slightly more in the autumn than in the winter, will probably cause increased precipitation and prolonged growing season, and consequently shrub increase and elevated timberline. The reindeers ability to utilize the increased vegetation biomass is however uncertain. A shift in the summer and winter pasture ratio is likely to occur, with increased stay in the summer pasture lands. More unstable winters may cause increased frequency of freeze-thaw cycles and accordingly blocked pastures in continental areas. Oceanic reindeer farming areas will on the other hand get better winter pastures.
The adaptation capacity is quite varying between different areas; due to high reindeer density and increased internal competition on pasture land in Finnmark, and more alternative pasture land in Troms and Trøndelag.

Reference

Norut Alta Report 2008:6:
http://www.finnmark.norut.no/norut_alta_lt/publikasjoner/rapporter/reindrifta_i_et_skiftende_klimabilde

Reindrifta ved et klimatisk veiskille?

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Reindrifta klarer seg bra til tross for et stadig varmere klima, men må regne med større tilpasninger i framtida. Det viser prosjektet "Effects in Sapmi", som har studert klimautviklinga og følger for samisk reindrift de siste 50-100 år, samt drøftet mulige konsekvenser i framtida.
"Effects in Sapmi" var et delprosjekt i forskningsprosjektet "PhenoClim" (Phenology as an indicator of climate change effects), finansiert av NFR (Norges forskningsråd) i årene 2003 til 2008. "PhenoClim" beskriver blant annet endringer i vekstsesongen på Nordkalotten i perioden 1982 til 2003, basert på fenologiske hendelser som tidspunkt for lauvsprett og lauvfall. Delprosjektet "Effects in Sapmi" har hatt fokus på endringer i vintersesongen og bygger på egne analyser av meteorologiske feltdata, beskrivelser av driftsmønster før og nå og årsmeldinger fra lappefogder og reinbeiteområder gjennom mer enn 50 år, samt intervjuer med erfarne reineiere og reindriftsforvaltere. I tillegg bygger prosjektet på annen forskning, blant annet PhenoClim og klimascenarier fra prosjektet RegClim.
Analysene viser at klimaet er blitt mildere og vekstsesongen lengre, men uten større endringer i driftsmønster. Endringene som vi ser er ikke direkte klimarelatert. I Finnmark er endringer i driftsmønster i stor grad tilpasninger til andre driftsgrupper. I Nord-Trøndelag og Nordland er dette tilpasninger til inngrep og andre arealbruksinteresser. Reindrifta er vant til å endre driftsmønster og beitebruk etter vær- og beiteforhold fra år til år. Enkelte varme og noen svært kjølige somre har likevel gitt problemer. Noen vintre har det vært låsing av beiter og forholdsvis store tap, men dette har delvis vært en følge av høy reintetthet og større sårbarhet.
En forventa temperaturstigning på 2 til 4 grader på 100 år, litt mer om høsten enn vinteren, vil gi sannsynlighet for mer nedbør og lengre vekstsesong. Det vil føre til tilgroing av åpne heisamfunn, heving av skog- og tregrense og følgelig mer skogsbeite og mindre fjellbeite. Det er usikkert om reinen kan gjøre seg nytte av den økte biomasseproduksjonen. Det er sannsynlig med en forskyving av balansen mellom sommer- og vinterbeiter med lengre opphold i sommerbeiteområdene. Klimautviklinga vil kunne gi mer usikker beitetilgang i kontinentale beiteområder på grunn av ustabile vintre med hyppigere ising og låsing av beiter. Havnære områder kan derimot oppleve sikrere og mer stabile vinterbeiter.
Det er store forskjeller i tilpasningsmulighetene mellom nord og sør. Stor reintetthet og trangt mellom driftsgruppene særlig vinterstid i Finnmark, vil øke usikkerheten om beitetilgangen. I Troms og Trøndelag har man større tilgang til alternative beiteområder.

Referanse
Norut Alta Report 2008:6:
http://www.finnmark.norut.no/norut_alta_lt/publikasjoner/rapporter/reindrifta_i_et_skiftende_klimabilde

National parks and reindeer management in Norway

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Classical nature conservancy and Sami reindeer management should ideally have common interests in taking care of nature for the future. Based on the authors' experiences with the reindeer industry during three decades, we have analyzed the relations between national parks and other categories of great protection areas and the reindeer industry. The starting point is the experiences and understandings of active reindeer managers of protection areas and protection processes registered by a survey. This material is complemented by conversations with researchers, employees of environmental agencies, some politicians, participant observation in and connected to protection areas, other field trips and studies of literature. We have considered effects on reindeer management by nature protection and vice versa.

The relations between reindeer management and nature protection are more difficult than most outsiders would expect. Protection has turned out positively for reindeer management and reindeer management for protection in some protection areas in Norway, but definitely not all. Border issues, by-laws and attraction affects of national parks – have unfortunate effects in some cases. This is especially the case where national parks are situated in spring, summer and also all-year areas for reindeer management, while national parks in winter areas are less conflicting. The accessibility of the areas for tourists and local people are also an influencing factor.

National parks (IUCN protection category II) aim to take care of both biological diversity and recreation interests. This fact includes a potential of conflict. Since the 1960s, modernization through economical and technological development has created a basis for new conflicts. On the one hand, road web development and family car use and also expansion of secondary home development have increased the use pressure on nature and reindeer management areas. On the other hand, reindeer industry use of ATVs contributes to changes in landscape appearance deviating from the expectations of pristine nature.

Changes in Norwegian protection policy since the turn of the millennium by the so called Mountain Text aiming to advance industrial development in protection areas based on eco-tourism, reinforces the recreation interests and increases the pressure on reindeer management, especially when the protection areas includes reindeer summer land. We see a clear need to reinforce the position of reindeer management in protection areas related to recreation interests. This could be achieved in parallel with taking care of the nature protection aspect. We consider the IUCN protection category VI *"Managed Resource Protected Area"* to be a good basis as it juxtaposes sustainable use and maintenance of biological diversity. This creates opportunities for combination of traditional use and conservation of original nature but at the premises of the traditional use, in this case Sami reindeer management. This would make reindeer management in protection areas a practical option. Active use, where also reindeer management takes care of nature, is the best protection.

This includes recognition that reindeer management areas are Sami cultural landscapes in stead of pristine nature. As an outcome of consultations the Sami Parliament and the Ministry of Environment have agreed that the new Act of Biodiversity will recognize and stress Sami indigenous knowledge as a part of the knowledge base for public decisions influencing biodiversity. This means that Sami use, including users of Sami culture and industries can contribute to sustainable use and nature protection will be better integrated with scientific knowledge before governmental decisions. We consider this as considerable progress for reindeer management interests, but it is conclusive that this implemented and fulfilled in practice.

Based on a number of preconditions we will recommend protection area expansion, more adequate borders and by-laws adapted to a modern and sustainable reindeer management. The current national park plan is by the government intended to be completed during 2009. When the plans are fulfilled about 15% of Norway's land surface is protected, and about one half of this is actively used reindeer management land. Therefore it is very important that the protection authorities not only listen to the reindeer industry but also take its recommendations seriously.

Nasjonalparker og reindrift i Norge

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Klassisk naturvern og samisk reindrift burde ideelt sett hatt felles interesser i å ta vare på naturen for framtida. Med bakgrunn i forfatternes erfaringer med reindriftsnæringen gjennom tre tiår har vi analysert forholdet mellom nasjonalparker/andre kategorier av større verneområder og reindriftsnæringen. Utgangspunktet er aktive reindriftsutøveres erfaringer med og oppfatninger av verneområder og verneplanprosesser kartlagt gjennom en spørreundersøkelse. Dette materialet er supplert med samtaler med forskere, ansatte i miljøforvaltningen og enkelte politikere, deltakende observasjon i og i tilknytning til verneområdene, andre befaringer og litteraturstudier.
Vi har sett på virkninger av naturvern på reindrifta og vice versa. Relasjonene mellom reindrift og naturvern er vanskeligere enn det de fleste utenforstående ville forvente. Vern har vist seg å være gunstig for reindrifta og reindrifta bra for vernet i noen verneområder i Norge, men slett ikke alle. Grensedragning, forskrifter, samt "trekkplastereffekten" av nasjonalparker får av og til uheldige virkninger. Spesielt gjelder dette nasjonalparker i vår-, sommer- og også helårsområder for reindrifta, mens parker i rene vinterområder er mindre konfliktfylt. Hvor tilgjengelige områdene er for turister og lokalbefolkning spiller også inn her.
Nasjonalparker (IUCNs vernekategori II) forutsettes å ivareta både biologisk mangfold og rekreasjonsinteresser. Dette rommer i seg selv et konfliktpotensiale. Siden 1960-tallet har modernisering gjennom økonomisk og teknologisk utvikling skapt grunnlag for nye konflikter. På den ene siden har utbyggingen av veinettet og privatbilismen samt ekspansjon i utbyggingen av fritidsboliger økt brukspresset på naturen og reindriftas driftsområder. På den andre siden bidrar reindriftas bruk av barmarkskjøring til endringer i landskapsbildet som avviker fra det som forventes i "urørt" natur.
Endringene i norsk vernepolitikk etter årtusenskiftet gjennom den såkalte Fjellteksten som tar sikte på tilrettelegging for næringsutvikling i verneområder basert på økoturisme, styrker rekreasjonsinteressene og øker presset på reindrifta, særlig når verneområdene omfatter sommerbeiteområder.
Vi mener at det er et klart behov for å styrke reindriftas posisjon i verneområdene i forhold til rekreasjonsinteressene. Dette kan gjøres samtidig som naturvernaspektet ivaretas. Vi anser at IUCN's vernekategori VI "*forvaltet ressursbeskyttelsesområde*" ville være et godt utgangspunkt da denne sidestiller bærekraftig bruk og opprettholdelse av biodiversitet. Dette gir mulighet for å kombinere tradisjonell bruk og vern av den opprinnelige, men på den tradisjonelle brukens, i dette tifelle den samiske reindriftas premisser. Dette vil gjøre det praktisk mulig å drive reindrift i nasjonalparkene. Aktiv bruk, hvor også reindrifta tar hensyn til naturen, er det beste vern. Dette innebærer en anerkjennelse av at reindriftsområdene er samisk kulturlandskap framfor "urørt" natur.
Etter konsultasjoner har Sametinget og Miljøverndepartementet blitt enige om at den nye naturmangfoldloven skal anerkjenne og vektlegge samisk tradisjonell kunnskap/árbediehtu som en del av kunnskapsgrunnlaget ved offentlige beslutninger som berører naturmangfoldet. Dette innebærer at samisk bruk, herunder utøvere av samisk kultur og næring som kan bidra til bærekraftig bruk og bevaring av naturen, blir bedre integrert med vitenskapelig kunnskap i forkant av myndighetsutøvelse. Vi ser dette som et betydelig framskritt for reindriftas interesser, men det er avgjørende at dette gjennomføres og får en praktisk oppfølging.
Ut fra visse forutsetninger er derfor våre anbefalinger at verneområdene utvides, grensene gjøres mer hensiktsmessige og forskrifter og regelverk tilpasses en miljøvennlig, moderne og framtidsrettet bærekraftig reindrift. Den nåværende nasjonalparkplanen skal etter Regjeringens intensjoner sluttføres i løpet av 2009. Når planene er gjennomført er om lag 15% av Norges areal vernet, og omtrent halvparten av dette ligger i aktivt brukte reindriftsområder. Det er derfor svært viktig at vernemyndighetene ikke bare lytter til reindrifta, men også tar anbefalingene fra næringen på alvor.

Is traditional ecological knowledge important to the reindeer herding industry?

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Extended abstract: In Scandinavia larger scale reindeer husbandry was founded during the 1600th century (Lundmark, 1989). Earlier the Sami had kept a few tamed reindeer. Female reindeer could be utilized to entice wild reindeer to come into traps and the Sami also used tamed reindeer as pack and draft animals and for milking. Slaughter animals were (mostly) hunted among wild reindeer. The Sami designation for domesticated reindeer is boazu attributed to the word milking, while wild reindeer are called goddi that can be compared to the verb kill.
When examining traditional ecological knowledge it is important to understand that the richness of detail in the language is often tied to the culture-bearing language used in the daily work. The Sami languages are known for its extensive terminology for describing many natural occurrences (Ruong, 1964, 1968; Jernsletten, 1997; Ryd, 2001; Helander-Renvall, 2007). It has roughly 300 words for snow according to texture, appearance and how the snow is to travel on or to dig in for the reindeer. The Sami languages are also rich on the subject of reindeer and there are special names for reindeer of different age and sex, hair colour and on different type of antlers. In all communication, use of a common language and terminology are of utmost importance for a successful transfer of knowledge. The reindeer herders can effortlessly convey a very precise description of any reindeer.
Sami traditional ecological knowledge is such knowledge that you need to be a successful reindeer herder. My working hypothesis was that the herders to be skilled reindeer herders knew the plants reindeer utilized. To find out how well the reindeer herders were in recognizing plants at the species level, I did a survey in some selected Sami communities (samebyar in Swedish). Besides the species level, I also speculated if the herders used another plant designation or classification than scientists to be more functional in their daily work. My informants were 22 herders from the communities Gabna, Laevas, Girjas, and Udtja and they were asked to identify or tell if they recognised the plant species in question. They would also comment on whether or not the plant was one the herders knew was grazed by reindeer, and they were finally asked to characterize a good winter pasture. Forty vascular plants were shown on picture to each informant.
The herders identified a total of 21 plant taxa and five plant groups. They especially recognised species like berries and forbs such as *Angelica archangelica* ssp. *archangelica* and *Rumex acetos.* These species are also widely known by the Sami since they traditionally have been used in their diet, but certain specific forage plants were also identified. Grasses did not have names at the species level but there was a clear and uniform nomenclature for a group of grasses called sitnu (*Deschampsia flexuosa* ssp. *flexuosa, D. alpina, Festuca ovina* and *Poa alpina*). All the informants did identify the grasses sitnu and 11 of them also gave descriptions that confirmed the name they had used for these specific grasses. The grasses they called rássi included different species of grass and forbs that reindeer graze during the summer. It is obvious that the informants distinguished between sitnu and rássi.
The herders were asked to identify and name different dried lichen species and to describe a good winter grazing land. To describe a good winter pasture they had to rank seven boxes with different amount and species of lichens and with different kind of mosses and dwarf scrubs. They also gave a reason of the ranking.
The Sami nomenclature is more detailed for plants grazed in seasons with forage shortage (autumn-, winter-, and springtime), and the herders had very good knowledge of what plants the reindeer grazed, especially about the lichens. According to all the informants, lichens were the most important fodder for the reindeer's welfare during the winter season, and in view of this importance, the informants also had a uniform nomenclature (Inga, 2007). Among the reindeer herders the lichen terminology was clear in relation to habitat and appearance: jeagil (North-Sami) or visste (Lule-Sami) for fructiose

lichens on the ground, lahppu for tree living pendulous lichens and gatna for foliose or crustose lichens that live on trees or on rocks.

The reindeer herders paid more attention to the conditions of the snow than the amount of lichens in the winter grazing land. The discussions where the informants were to rank seven boxes of different plant communities, gave some information on what the reindeer herders considered to be important features of good winter foraging areas. Firstly, they mentioned to what extent the lichens covered the ground and rated the boxes after that. For the next, they discussed the snow cover, how deep it could be and if certain boxes represented areas where the snow was easy to dig for the reindeer.

Detailed knowledge on the plant level was surprisingly scarce, indicating that the knowledge of range resources is of vital importance on a general but not on a more detailed level. This fact is in sharp contradiction to the detailed knowledge that Sami people express for example about reindeer (as an animal) or snow (as physical element). The plausible explanation is that observations of plant species are unnecessarily detailed information in large scale reindeer pastoralism, because the animals graze freely under only loose herding and border surveillance.

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Är traditionell ekologisk kunskap viktig för rennäringen?

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I Skandinavien grundlades "dagens" renskötsel under 1500-talet (Lundmark, 1989) och före det hade samerna ett fåtal tämjda renar som man använde som lockrenar, mjölk, klövje- och dragdjur. Slaktdjur jagade man bland den vildrenspopulation som levde här. Den domestiserade renen kallas boazu, ett namn som kan härledas till ordet mjölka medan vildren heter goddi som kan jämföras med ordet döda. Detaljrikedomen är ofta knuten till det kulturbärande språket som används i det dagliga arbetet, i detta fall samiska, som är känd för sin omfattande terminologi för att beskriva olika naturfenomen (Ruong, 1964, 1968; Jernsletten, 1997; Ryd, 2001; Helander-Renvall, 2007). I samiskan finns det 300 ord för snö vad gäller konsistens, utseende och hur snön är att färdas på eller att gräva i. Dessutom finns en mängd ord för hur renen kan se ut, speciella namn på ålder och kön, på hårfärg, färgteckningar och hur geviret ser ut. Utan att se renen kan en sådan muntlig beskrivning ge en bra bild av renens kön, ålder och utseende. I all kunskapsöverföring är språket och/eller terminologin av största betydelse för att överföringen ska lyckas.

Min arbetshypotes var att renskötare måste känna igen renbetesväxter för att vara en bra renskötare. För att undersöka om renskötare känner växter på artnivå har jag valt ut ett antal samebyar som ligger i det samiska språkområde jag behärskar. Jag har, förutom att vara intresserad av ren artkunskap, också funderat på om man har någon annan växtindelning som är mer funktionell för en renskötare än den som vetenskapen använder. Som informanter har 22 renskötare från samebyarna Gabna, Laevas, Girjas och Udtja fått a) identifiera och namnge växter antingen på samiska eller svenska; b) ange vilka växter renen betar; c) specifiera under vilken tid på året olika växter betas och d) karaktärisera ett bra vinterbete.

Av de 40 kärlväxter som informanterna fick se på bild så var det 21 växtarter och fem växtgrupper som informanterna kände igen. Växter som traditionellt har nyttjats i kosthållet såsom bär, fjällkvanne (*Angelica archangelica* ssp. *Archangelica*) och fjällängssyra (*Rumex acetosa*) kände de flesta informanterna till, men de identifierade också vissa betesväxter. Gräs har inget namn på artnivå, men det finns en klar och entydig nomenklatur på en grupp av gräs som kallas sitnu (*Deschampsia flexuosa* ssp. *flexuosa, D. alpina*, *Festuca ovina* och *Poa alpina*). Alla informanter identifierade gräsen sitnu och 11 av den gav också en beskrivning som bekräftar namnet de har använt på dessa specifika gräs. Det gräs som kallas rássi innefattar även olika arter av gräs och örter som renen betar under sommaren. Det är uppenbart att de skiljer på sitnu och rássi.

Renskötarna fick i uppgift identifiera och namnge olika lavarter samt att beskriva ett bra vinterbetesland. För att beskriva ett bra vinterbetesland fick de rangordna sju lådor med olika mängd lav och olika lavarter samt med olika mossor och ris. I samband med rangordningen fick de också motivera sin rangordning.

Det framgår tydligt att den samiska nomenklaturen på olika renbetesväxter är mer detaljerad då det gäller växter som betades under perioder då det var ont om bete. Särskilt tydligt är det när det gäller samisk nomenklatur på lavar, som har namn efter utseende och växtplats (Inga, 2007). Marklevande busklavar heter jeagil (nordsamisk) eller visste (lulesamisk), trädlevande hänglavar lahppo, och blad- och kartlavar som växer på träd eller sten heter gatna.

Då det gäller vinterbeteslandet lägger renskötarna större vikt vid hur snön ser ut än mängden lav. Diskussionen som uppkom under experimentet att rangordna olika växtsamhällen, gav viss information på vad renskötarna menade vad som var viktigt för bra vinterbetesland. Först såg det hur mycket laven täckte marken och rangordnade efter det. Sedan diskuterade de snötäcket, hur djupt det förmodades vara och om vissa lådor representerade områden där snön var lätt att gräva i för renarna.

Detaljerad kunskap på växtartnivå var överraskande begränsad, vilket antyder att kunskap om markresurserna är av större betydelse på en övergripande, men inte på detaljerad nivå. Detta är i skarp kontrast till den detaljerade kunskapen samerna visar vad gäller renen (som ett djur) eller om snö (som ett fysiskt element). Den tänkbara förklaringen är att observationer på växtartnivå är en onödig detaljerad information i en storskalig renskötsel pastoralism, eftersom djuren betar fritt i betesområdet.

Inside or outside? An academic reflection of the position of reindeer husbandry in the majority society

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The presentation will focus on the reindeer herding industry`s position in today's society and ask whether the development that can be seen today in the interaction between the industry and society is a desirable way to go. Reindeer industry throughout the Circumpolar area is dependent on the access to good pastures. At the same time we see a trend throughout this region where pastures in greater and greater degree are fragmented or completely destroyed. How do we handle such a development?
Historically, the contract reindeer system and guest relationship (Sami: verddevuohta) with the local population have been important elements in bridging the needs of both the industry and society. Such institutions have contributed positively to an increased understanding between different actors. The general picture today is that both the contract reindeer system and guest relationship (vérddevuohta) is weakening (or no existing) and that the industry's challenges increasingly seek to be resolved through different national legal systems. But there is one important exception from this rule.
The concession reindeer system in Kalix- and Torne valleys in northernmost Sweden is an example where these traditions are still strong and have been regulated in the (Swedish) Reindeer Herding Act. The lecture will examine some selected parts of the concession reindeer system and show how this industry is based on a common understanding between reindeer owners and the local population. Despite its small number of animals and a rather invisible position in the academic mindscape, the concession reindeer management system is of importance politically as well as academically concerning the principles involved. This system is highly significant as an analytical model, and it offers not only problems but also solutions to many of the challenges the industry faces.

Innenfor eller utenfor? En faglig refleksjon over reindriftens plass i storsamfunnet

Foredraget fokuserer på reindriften sin posisjon i dagens samfunn og spør om den utviklingen man ser i dag i samhandlingen mellom næring og storsamfunnet er en ønsket vei å gå? Reindriften i hele det sirkumpolare området er avhengige av gode beiteområder. Samtidig ser vi en utvikling i hele dette området hvor beitene i større og større grad fragmenteres eller ødelegges helt. Hvordan kan man håndtere en slik utvikling?
Historisk har sytingsreinsystemet og verdderelasjoner (samisk: verddevuohta)med lokalbefolkningen vært viktige elementer i en brobygging mellom næringen og samfunnet rundt. Slike institusjoner har bidratt positivt for en økt forståelse mellom ulike aktører.
Det generelle bildet i dag er at både sytingsreinsystemet og verdderelasjoner er på sterk vikende front, eller blitt helt borte, og at næringens utfordringer stadig oftere søkes løst gjennom nasjonale retts-system. Men det finnes et viktig unntak fra dette bildet. Konsesjonsreindriften i Kalix- og Torne elve-daler er et eksempel på at disse tradisjonene fremdeles står sterk og at de er blitt regulert inn i den (svenske) nasjonale reindriftslovgivningen. Foredraget vil ta for seg noen utvalgte deler av denne organiseringen som er å anse som konfliktdempende og som bygger på gjensidig forståelse mellom reineierne og lokalbefolkningen. Selv om konsesjonsreindriften er (geografiske) marginal i den sir-kumpolare konteksten, og samtidig har en usynlig posisjon i det akademiske landskapet, så er konse-sjonsreindriften viktig hva gjelder de prinsippene vi finner her. Konsesjonsreindriften er meget relevant som en analytisk modell, og den tilbyr ikke bare utfordringer, men også løsninger til mange av de utfordringene som hele den sirkumpolare reindriftsnæringen står ovenfor i årene fremover.

Predicting growth of mat-forming lichens in northern Scandinavia using models as potential tools for management of lichen-rich habitats

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Mat-forming lichens are important components of the vegetation of boreal and arctic ecosystems and are the main reindeer forage during the winter. However, forestry has during the 20th century adversely affected lichen-rich habitats. To support the long-term management of these habitats we developed models for predicting growth of the species *Cladina stellaris* and *Cetraria islandica* in northern Scandinavia. These lichens were transplanted along a natural west–east climate gradient varying in precipitation, temperature and light exposure. Growth was then recorded seasonally over 16 months. We developed semi-mechanistic models of varying complexity based on descriptive meteorological data, irradiance, physiological data, and hydration models. The models ability to predict lichen annual growth was considered. In addition, to be able to identify habitats with high growth potential, more practical models were also evaluated. Annual growth ranged from 12.5% to 29% and 6.4% to 24.5% for *C. stellaris* and *C. islandica*, respectively. Growth was highest at the most open sites and irradiance was a limiting factor for sites with a canopy cover of more than ca 60%. Growth was even higher at more humid sites. Parameters related to irradiance predicted most of the annual growth for both species and could, in combination with precipitation, predict 52% of annual growth for *C. stellaris* and, in combination with total wet time and the irradiation received while wet, predict 66% of annual growth for *C. islandica*. The practical model predicted 43% of annual growth for *C. stellaris*, using basal area and the normal average temperature, and 24% for *C. islandica* using basal area alone. Management of lichen-rich habitats requires a knowledge of a habitat's potential for lichen growth. To attain this, we present models of lichen growth as a function of habitat properties and conclude that sufficient irradiance below forest canopy is of crucial importance in the long-term management of mat-forming lichens and easily recorded parameters can be used to identify appropriate habitats.

Modeller som verktyg för att förutsäga tillväxt av mattlevande lavar i norra Skandinavien – medel för att sköta lavrika habitat

Mattlevande lavar är viktiga för rennäringen som föda för renarna under vintern. Samtidigt har skogsbruket påverkat lavrika habitat negativt under de senaste hundra åren. För att stödja skötseln av dessa habitat har vi utvecklat modeller för att uppskatta tillväxten av lavarna fönsterlav och islandslav i norra Skandinavien. På så sätt kan man identifiera vilka habitat som utgör miljöer med högst tillväxtpotential av mattlevande lavar och som därmed också är viktiga ur ett rennäringsperspektiv.
Lavarna placerades ut i en öst-västlig gradient som varierade naturligt i nederbörd, temperatur och ljustillgång (omvänd krontäckning). Tillväxten följdes säsongsvis i 16 månader. Semi-mekanistiska modeller som byggde på meteorologiska data, ljustillgång, fysiologiska data och lavarnas vatteninnehåll utvecklades med varierande komplexitet. För att kunna identifiera vilka miljöer som har hög tillväxtpotential utvecklades också rent praktiska modeller som baserades på grundyta och meteorologiska normaldata. Den årliga tillväxten varierade från 12.5% till 29% för fönsterlaven och 6.4% till 24.5% för islandslav. Tillväxten var högst vid de mest öppna habitaten och var ljusbegränsad vid en slutenhet högre än 60% krontäckning. Tillväxten var också högre i habitat med mer nederbörd och i snitt högre relativ fuktighet. Den praktiska modellen förklarade 43% av variation i tillväxt hos fönsterlav med hjälp av grundyta och medeltemperatur. Motsvarande modell för islandslav förklarade 24% med grundyta. Mer komplicerade modeller kunde förklara upp till 52% för årlig tillväxt av fönsterlav och motsvarande 66% för islandslaven. För att sköta lavrika habitat krävs kunskap om ett habitats förmåga till lavtillväxt. De modeller som presenteras visar att tillräckligt öppna miljöer är den viktigaste faktorn för långsiktigt bruk av mattlevande lavar.

Effects of forestry on the winter grazing resources of reindeer in Sweden

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Reindeer husbandry and forestry are the main land users in boreal forests in northern Sweden. The boreal forest is mainly used for winter grazing by reindeer, although some herding districts may also use the forest during summer. In winter and early spring reindeer's diet consists up to 80% of mat-forming terrestrial lichens (*Cladina, Cetraria*) and arboreal lichens (*Bryoria, Alectoria, Usnea*) and these winter resources thus create a bottle-neck for the reindeer herding system. Commercial cultivation and extraction of timber have mainly negative effects on reindeer husbandry and conflicts between these two industries have escalated during the past century. For example, ground lichens may either be destroyed through soil scarification or become inaccessible due to logging residues. Young forest stands may have a high canopy cover which restricts the light reaching the ground and reduce lichen growth. Dense young forests may also hinder the movement of reindeer. The abundance of lichens can decrease as a result of nitrogen fertilization. Furthermore, reindeer have been observed to avoid grazing in fertilized forest stands. Arboreal lichens are key resources during late winter when snow conditions make it difficult for the reindeer to dig for ground lichens. Due to slow growth rates and limited dispersal, arboreal lichens are strongly dependent on old forests and continuity in canopy cover. Harvesting of trees and short rotation times will thus have strong negative effects on the amount of arboreal lichens.

In general, modern forest management has resulted in increasing proportion of even-aged young stands and scarcity of old-growth stands. The changes in the forest landscape structure were measured in two study areas (Akkajaur-Abraur and Eggelats) located in northern Sweden using digitized historical maps. The results showed that the cover of continuous old pine forest had decreased from ca 47-59% in the beginning of the 20th century to only 9-14% in 2006. Furthermore, the mean patch size of continuous pine forests had strongly decreased and the degree of fragmentation increased during the past 100 years. Correspondingly, the cover of young forests has increased in the studied landscapes. Small and fragmented patches of suitable pastures cannot be effectively used for reindeer herding. Furthermore, decreasing size and increasing isolation of old forest patches hamper the dispersal of arboreal lichens in the landscape. Climate change is likely to exacerbate the effects of forestry on reindeer husbandry as increased forest productivity will result in denser forests with shorter rotation times.

Metsätalouden vaikutukset porotalouden talviresursseihin Ruotsissa

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Poronhoito ja metsätalous ovat kaksi merkittävintä maankäyttömuotoa boreaalisissa metsissä Pohjois-Ruotsissa. Boreaalisia metsiä käytetään porojen talvilaidunnusalueena ja tämän lisäksi joillain alueilla porot laiduntavat metsissä myös kesäisin. Talvella ja varhain keväällä maajäkälät (esim. *Cladina, Cetraria*) sekä puissa kasvavat naava (*Usnea*) ja luppo (*Bryoria, Alectoria*) muodostavat jopa 80% porojen ruokavaliosta ja siten nämä resurssit muodostavat poronhoitojäjestelmän "pullonkaulan". Metsätaloudella on enimmäkseen negatiivisia vaikutuksia porotalouteen ja ristiriidat näiden kahden maankäyttömuodon välillä ovat kasvaneet viime vuosisadan aikana. Esimerkiksi maajäkälät voivat laajalti tuhoutua maan muokkauksen yhteydessä, ja hakkuujätteet estävät maajäkälien kaivamista. Nuorten metsien tiheä latvuspeitto voi rajoittaa valonmäärää pohjakerroksessa ja vähentää jäkälien kasvua. Samoin porojen liikkuminen voi vaikeutua tiheissä nuorissa metsissä. Jäkälien määrä voi vähentyä typpilannoituksen seurauksena. Porojen on havaittu myös välttävän laiduntamista typpilannoitetuissa metsissä. Lupot ovat avainresurssi lopputalvesta, jolloin vaikeat lumiolosuhteet estävät poroja kaivamasta jäkälää maasta. Hitaan kasvunopeuden ja rajoittuneen leviämiskyvn vuoksi luppoja esiintyy enimmäkseen vanhoissa metsissä. Hakkuilla ja lyhentyneellä hakkuukierrolla on siten merkittäviä negatiivisia vaikutuksia luppojen määrään.
Nykyaikainen metsätalous on johtanut tasaikäisten nuorten metsien kasvavaan osuuteen ja vanhojen metsien vähenemiseen. Metsämaisemassa tapahtuneita muutoksia mitattiin kahdella tutkimusalueella (Akkajaur-Abraur ja Eggelats) Pohjois-Ruotsissa digitoitujen historiallisten karttojen avulla. Tulokset osoittivat että vanhan mäntymetsän peittävyys on vähentynyt noin 47-59%:sta 1900-luvun alusta 9-14%:iin vuonna 2006. Vanhan metsän muodostamien laikkujen keskikoko on myös huomattavasti pienentynyt ja pirstoutuminen lisääntynyt viimeisen sadan vuoden aikana.Vastaavasti nuoren metsän peittävyys on lisääntynyt tutkimusalueilla. Sopivien laidunten väheneminen ja pirstoutuminen johtaa siihen, että niitä ei voida hyödyntää tehokkaasti porolaidunnukseen. Samoin vanhan metsän laikkujen pieni koko ja laikkujen eristäytyminen vaikeuttavat luppojen leviämistä uusille alueille. Ilmastonmuutos vahvistaa todennäköisesti metsätalouden vaikutuksia porotalouteen metsien tuottavuuden kasvaessa, joka johtaa tiheämpiin metsiin ja lyhyempiin hakkuukiertoaikoihin.

Different land use pressures and the present state of reindeer winter ranges in northernmost Finland

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In the Finnish reindeer herding area various forms of land use operate in the same area, often with overlapping operational ranges and interests. Forestry, tourism and mining as well as settlements and holiday and recreation infrastructure use and continuously change the reindeer herding environment. At the same time, also reindeer herding affects pasture areas by causing changes in the vegetation. All of these have certain effects on the state of pasture environment and possibilities to practice reindeer herding, therefore, it is necessary to monitor the extent and causes of these changes. This kind of comprehensive evaluation of the state of the environments is becoming increasingly more important if our aim for the future is to use natural resources in an ecologically sustainable and, at the same time, more pluralistic way.

The aims of the present project were to survey the present state of pasture environments and also to investigate recent changes in the winter ranges in the 20 northernmost reindeer herding districts of Finland (the specific reindeer herding area). The study was conducted during 2005-2008 by the Finnish Game and Fisheries Research Institute using improved and more diversified field and image classification methods. This pasture inventory produced a versatile and accurate picture on the present condition of lichen pastures and the general state of winter range environments. However, the extent and causes of changes occurring in the pasture environment should be studied in more detail.

The results of the inventory showed that lichen ranges were to a large extent heavily worn out in the studied herding districts and their pasture areas (lichen biomass under 300 kg/ha). Lichen ranges in good (lichen biomass > 1000 kg/ha) or moderate (lichen biomass 500-100 kg/ha) condition still occur in those pasture areas where reindeer grazed only during winter and which, at the same time, were located in conservation areas outside the operational range of forestry and infrastructure. The most heavily worn out lichen ranges were located in the mountainous areas and also in middle and western Lapland, where reindeer densities on lichen ranges have been relatively high. In these districts, it has also been difficult to develop well-designed annual pasture rotation systems; therefore, reindeer have grazed lichen ranges also during the summer season (whole snow free period). From the mid 1990s to the period 2005 to 2008, the lichen biomasses on lichen ranges have decreased in the studied field sites in most of the districts. The long term effects of forestry appeared clearly in those reindeer herding districts located in the operation ranges of forestry, where forest and landscape structure has been fragmented into a mosaic of felled and sapling stand areas and young forests. At present, large and continuous winter range areas with old growth forest can be found only in conservation areas. Also the continuous increase of infrastructure constructions in the reindeer herding environment has intensified the fragmentation of winter ranges. Altogether in 11 of all studied herding districts, the areas of coverage and impact by infrastructure formed 5% to 27% of the total land area, but in the backcountry districts these amounts were smaller.

The results suggest that, besides regulation of the number of reindeer, for a lasting improvement of lichen ranges attention should be paid to developing and employing well-working annual pasture rotation systems. Because the effects of forestry and infrastructure are usually negative on the state and usability value of winter ranges, reindeer herding should be taken more into consideration than previously when implementing forestry operations or expanding infrastructure especially in the northern part of reindeer herding area. Besides the effects of long term reindeer densities the effects of the grazing methods of pastures and impact of other land use forms on the state of lichen ranges should be studied in more detail. At the same time, the possible link of air pollution emissions from Nikel in Russia to the marked reduction of lichens in the eastern Inari area should be studied in more

detail. The evaluation of the state of the reindeer herding environments should also be more versatile, expanding co-operation and combining resources from the Finnish Game and Fisheries Research Institute, the Finnish Forest Research Institute and the Finnish Environment Institute. In this way reindeer pasture inventories would also act as an important tool for observing the state of environments.

Erilaiset maankäyttöpaineet ja porojen talvilaidunten nykytila pohjoisimmassa Suomessa

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Useiden eri maankäyttömuotojen toiminta-alueet ja intressit menevät päällekkäin Suomen poronhoitoalueella. Metsätalous, matkailu ja kaivostoiminta sekä asutus ja loma- ja virkistysrakentaminen hyödyntävät ja muuttavat koko ajan koko ajan luonnonympäristöä, jossa myös poronhoito toimii. Samalla myös poronhoito vaikuttaa laidunalueisiin kasvillisuusmuutosten kautta. Kaikki nämä muutokset vaikuttavat jollain tavalla laidunympäristön tilaan ja poronhoidon toimintaedellytyksiin, mistä johtuen erilaisten muutosten laajuutta ja syitä poronhoidon laidunympäristössä olisi kyettävä seuraamaan. Tällainen kokonaisvaltainen ympäristön tilan seuranta nousee entistä tärkeämmäksi pyrittäessä mm. ekologisesti kestävämpään ja moniarvoisempaan luonnonvarojen käyttöön.

Vuosina 2005–2008 toteutettiin RKTL:n vetämänä tutkimushanke, jonka tavoitteena oli inventoida aikaisempaa tarkemmilla ja monipuolisemmilla inventointimenetelmillä talvilaitumet ja kartoittaa laidunympäristöjen tila sekä selvittää laidunten tilan muutoksia poronhoitoalueen pohjoisosan 20 paliskunnassa (ns. erityisesti poronhoitoa varten tarkoitettu alue). Inventointi rahoitettiin osittain MAKERA:n tutkimusvaroilla. Laiduninventointi antoi entistä monipuolisemman ja luotettavamman kuvan paliskuntien jäkälälaidunten kunnosta ja talvilaidunympäristön nykytilasta. Sen sijaan laitumilla tapahtuneiden muutosten laajuutta ja näiden muutosten syitä tulee jatkossa selvittää vielä tarkemmin.

Laiduninventoinnin tulokset osoittivat jäkälälaidunten olevan suuressa osassa paliskuntia ja laidunalueita voimakkaasti kuluneita (jäkäläbiomassa alle 300 kg/ha), mutta hyväkuntoisia (jäkäläbiomassa yli 1000 kg/ha) tai kohtuullisessa kunnossa (jäkäläbiomassa 500–1000 kg/ha) olevia jäkälälaitumia löytyi tutkituista paliskunnista edelleen niiltä talvilaidunalueilta, joissa porot laiduntavat pääosin vain talvella ja jotka samalla sijaitsivat metsätalouskäytön ja infrastruktuurin ulkopuolella olevilla suojelualueilla. Voimakkaimmin kuluneet jäkälälaitumet sijoittuivat tunturialueille sekä Länsi- ja Keski-Lapin alueille, joissa porotiheydet jäkälälaidunten pinta-alaa kohti ovat olleet suhteellisen korkeat. Näissä paliskunnissa ei myöskään ole usein voitu kehittää toimivaa vuodenaikaista laidunkiertoa, minkä vuoksi porojen laidunnus on kohdistunut laajasti jäkälälaitumille myös kesäkautena (lumettomana aikana). Jäkäliköiden jäkälämäärät olivat pudonneet tutkituilla koealueilla useimmissa paliskunnissa 1990-luvun puolivälistä vuosiin 2005–2008 tultaessa. Metsätalouden pitkäaikaiset vaikutukset talvilaitumiin näkyivät selvinä metsätalousalueella sijoittuvissa paliskunnissa, joissa metsä- ja laidunkuva on voimakkaasti pirstoutunut pääosin hakkuualueiden, taimikoiden ja nuorten metsien mosaiikiksi. Käytännössä laajimmat ja yhtenäisimmät varttuneiden ja vanhojen metsien talvilaidunalueet löytyvät tällä hetkellä enää suojelualueilta. Myös infrastruktuurin liittyvien rakenteiden vähittäinen lisääntyminen porolaitumilla on voimistanut talvilaidunalueiden pirstoutumista. Yhteensä 11 paliskunnassa infrastruktuurin peitto- ja vaikutusalueet kattoivat 5-27% paliskuntien maa-alasta, mutta erämaapaliskunnissa jäivät tämän alapuolelle.

Tulokset viittaavat siihen, että poromäärien säätelyn ohella tulisi kiinnittää entistä enemmän toimivien laidunkiertojärjestelmien kehittämiseen ja toteuttamiseen paliskunnissa, jotta jäkälälaidunten tilaa voitaisiin parantaa pitkällä aikavälillä. Koska metsätalouden ja infrastruktuurin vaikutukset ovat

talvilaidunten tilan ja käytettävyyden kannalta yleensä negatiivisia, tulisi metsätalouden toiminnassa ja infrastruktuurin laajentamisessa voida huomioida poronhoito entistä paremmin erityisesti poronhoitoalueen pohjoisosassa. Pitkäaikaisten porotiheyksien vaikutusten lisäksi laidunten käyttötavan ja muun maankäytön vaikutuksia jäkälälaidunten kuntoon on syytä tutkia yksityiskohtaisemmin. Samalla mm. Venäjän alueella sijaitsevan Nikkelin saastepäästöjen mahdollista yhteyttä Itä-Inarin alueella havaittuun jäkälämäärien voimakkaaseen vähenemiseen pitäisi tutkia vielä tarkemmin muiden vaikutustekijöiden ohella. Porolaidunympäristön tilan seurantaa olisi myös kehitettävä entistä monipuolisemmaksi laajentamalla yhteistyötä ja yhdistämällä resursseja mm. RKTL:n, METLA:n ja SYKE:n välillä. Tällöin laiduninventoinnit toimisivat osaltaan myös ympäristön tilan seurantaan liittyvinä työkaluina.

Ecological implications of petroleum industry to Nenets reindeer herding in Yamal Peninsula, Arctic Russia

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The aim of the this research is to assess the capacity for satellite imagery in detecting different natural and anthropogenic land cover changes in the vicinity of a modern petroleum extraction development in the Russian Arctic. The Yamal Peninsula in northwest Siberia contains some of the largest untapped deposits known in the world. It also serves as the homeland of the Yamal Nenets, who have exploited first wild and then domestic reindeer in the region for at least 1000 years. Their annual migration from the treeline to the northern tundra brings them into contact with a number of impacts associated with gas exploration and production. These range widely and include physical obstructions from roads, railways, and pipelines, as well as direct and indirect ecological impacts, such as changes in vegetation, soils and hydrology due to e.g. drilling, infrastructure development, and seismic surveys. Some of the effects are relatively small-scale, only a few meters across, while others cover several hectares. Nenets' perceptions of the spatial aspects of their territories encompass changes in both quantity and quality of terrestrial habitats, rivers, lakes and campsites that have been used seasonally for centuries. Satellite imagery used was Landsat MSS/TM/ETM, SPOT, ASTER TERRA VNIR and Quickbird-2. Even with most high-resolution imagery it was not possible to detect things like trash (rusted metal, broken glass), drilling muds and petro-chemicals that can strongly affect the overall quality of reindeer pastures.
In Bovanenkovo, 450 km^2 have been affected by the gas field and about 33 km^2 of the vegetation have destroyed or changed from original. Impacts are local and small scale but for example about 20% of late summer pastures of two reindeer herding brigades of Yarsalinksi sovhoze are directly affected by Bovanenkovo gas field. Especially migration through gas field has become more difficult after increasing constructions. Impacts can be drastical to certain brigades. To properly assess the overall ecological impacts of petroleum development requires a combination of state-of-the-art remote sensing coupled with detailed ground-truthing efforts that embrace both scientific and local knowledge from indigenous herders and also non-indigenous gas field workers.

Kaasuteollisuuden ekologiset vaikutukset nenetsi poron-hoitoon Jamalin niemimaalla, Pohjois-Venäjällä

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Tutkimuksessa pyrittiin arvioimaan satelliittikuvien soveltuvuutta maankäytön muutosten havainnointiin arktisen Venäjän öljyn- ja kaasuntuotantoalueilla. Jamalin niemimaalla Luoteis-Siperiassa sijaitsevat maailman laajimmat kaasuesiintymät. Nenetsit ovat harjoittaneet poronhoitoa Jamalilla satoja vuosia. Vuotuisen laidunkierron varrella metsänrajalta Karanmeren rannikolle (1500 km), nenetsipaimentolaiset kohtaavat useita erilaisia kaasuteollisuuteen liittyviä kohteita. Öljy- ja kaasuteollisuuden vaikutukset tutkimusalueella voidaan jakaa karkeasti: suoranaisiin ympäristövaikutuksiin sekä vaikutuksiin poronhoitoyhteisöön. Ympäristövaikutukset vaihtelevat teistä, putkistoista, jätteistä, muuttuneesta kasvillisuudesta saastuneeseen maaperään tai veteen. Öljy ja kaasuteollisuuden vaikutukset tutkimusalueella voidaan jakaa karkeasti kahteen osa-alueeseen: suoranaisiin ympäristövaikutuksiin sekä vaikutuksiin poronhoitoyhteisöön. Osa vaikutuksista on hyvin pienialaisia, kuten muutaman metrin levyiset maastoajoneuvourat (vain) ja osa useita hehtaareja kuten maanottoalueet. Tutkimuksessa käytettyjä satelliittikuvia olivat Landsat MSS/TM/ETM, SPOT, ASTER TERRA VNIR ja Quickbird-2 -kuvat. Vaikeimmin havaittavia vaikutuksia satelliittikuvilta olivat yksittäiset erilaiset roskat ja jätteet (metalli, betoni, lasi). Kyseiset jätteet ovat puolestaan yksi merkittävimmistä laidunten arvoa alentavista tekijöistä; alueita joilla on porojen sorkkia mahdollisesti vahingoittavaa jätettä pyrkivät poropaimenet kokonaan välttämään.
Bovanenkovon kaasukentän vaikutusalue on noin 450 km^2. Noin 33 km^2 kasvillisuutta on tuhoutunut tai muuttunut toiseksi tyypiksi. Vaikutukset ovat lähinnä paikallisia ja suhteellisen pienialaisia, mutta esimerkiksi noin 20 prosenttia kahden Yarsalinskin sovhoosin poroprikaatin loppukesänlaitumista sijaitsee Bovanenkovon kaasukentän vaikutusalueella. Erityisesti porojen ja paimentolaisten kulkeminen kaasukentän läpi on vaikeutunut yhä lisääntyneen rakentamisen myötä. Näin ollen vaikutukset voivat olla paikallisesti erittäin merkittäviä. Ekologisten vaikutusten arviointiin tarvitaan kaukokartoitusmenetelmiä sekä kenttätöitä. Maankäytön muutosten tutkimuksen kannalta poronhoitajien paikallistuntemus sekä öljy- ja kaasuteollisuuden työntekijöiden tietämyksen huomiointi tuo tutkimukseen merkittävää lisäarvoa.

Reindeer husbandry, hydroelectric power development and reindeer husbandry research – a history

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The establishment of a more organized research on reindeer husbandry in Sweden is in many ways connected to the increased exploitation of the reindeer husbandry area, not least the development of hydroelectric power. Individual research projects on separate issues with connection to reindeer husbandry were carried out during the first half of the twentieth century but it was not until after World War II that a more structured organization was established. The start was modes, but was soon expanded, since the hydroelectric power development demanded both more dependable estimations of the value of the grazing land that was lost as well as finding measures to utilize the remaining grazing lands more rationally. This presentation will follow the development of reindeer husbandry research in Sweden from the first projects up until the start of the Nordic cooperation in this arena during the 1960s.

Renskötsel, vattnkraftsutbyggnad och renskötselsforskning – en historik

Tillkomsten av en mer organiserad forskning kring renskötseln i Sverige har många kopplingar till den ökande exploateringen av renskötselområdet, och då inte minst utbyggnaden av vattenkraften. Enskilda forskningsprojekt inom skilda områden med betydelse för renskötseln hade genomförts vid olika tillfällen under första halvan av 1900-talet, men det är under efterkrigstiden som en fast organisation skapas. Från en blygsam start utvidgades verksamheten snart, framför allt eftersom den pågående utbyggnaden av vattenkraften ställde krav både på säkrare bedömningar av värdet på den renbetesmark som gick förlorad liksom åtgärder för att mer rationellt utnyttja de betesmarker som återstod. Denna presentation kommer att beskriva utvecklingen av renforskningen i Sverige från de första projekten fram till starten för det nordiska samarbetet på renforskningens område på 1960-talet.

Cabins in reindeer grazing land: Reindeer husbandry interests in municipal planning processes

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Cabin construction is one of the most common human-made constructions in outlying fields used as reindeer grazing land in Norway. Cabins and people using cabins as a base for outdoor activities may disturb reindeer grazing patterns, and studies show that the majority of the herd may avoid grazing in areas nearer than 2 to 4 km. from cabin resorts. Currently, near 1000 cabins are built every year in Sami reindeer husbandry areas in Norway, with subsequent loss of grazing land.
The location and extent of areas set aside for cabin construction are decided through municipal planning processes resulting in comprehensive plans. These processes shall include reindeer husbandry representatives, ensuring that the planned cabin construction is not harmful for reindeer husbandry in the area. However, there are problems both with the municipalities' involvement of reindeer husbandry interests, as well as the participation of the representatives from the reindeer husbandry in these processes. These involvement - and participation problems relate to both comprehensive plans for whole municipalities, and local plans for specific construction areas, i.e. cabin resorts.
We have studied these problems both from a national perspective including the entire area of Sami reindeer husbandry in Norway (about 40% of the Norwegian land area), and from a case study perspective in three different areas (including five municipalities). The national analyses show that most of the comprehensive and local plan processes end with compromises allowing a lot of cabin construction. In addition some municipalities open up for numerous exemptions from the comprehensive plan, allowing cabin construction in areas where this was not originally allowed according to the comprehensive plan. The result is both more cabins and a more scattered cabin location pattern than the reindeer husbandry wants.
The case studies indicate that the municipal planning processes to a large extent are negotiation processes between conflicting interests; the municipalities welcome building activity because it generates employment and income, while the reindeer herders are negatively affected by increased construction activity in grazing areas. Thus the participation in the processes can often be strategic from both the municipalities and the reindeer husbandry representatives, and the mutual confidence between the municipalities and reindeer husbandry may be low, making communication between the parties difficult. Different views on how the plans will affect reindeer husbandry within different groups in the reindeer husbandry society, and between the local and regional representatives of the reindeer husbandry, also makes planning difficult for the municipalities. On the other hand, the municipalities' lack of understanding of the reindeer herds need for large areas of undisturbed grazing land, make it difficult to reach compromise solutions that the reindeer husbandry can cope with in the long perspective. Being a minor economic interest in most municipalities, reindeer husbandry is not given priority by the municipalities.

Hyttebygging i reinbeiteland: Reindriftsinteressenes posisjon i kommuneplanprosesser

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Hyttebygging er et av de vanligste inngrep i utmark som brukes som reinbeiteland i Norge. Hyttene og hyttefolkets aktiviteter forstyrrer reinflokkenes beitemønster, og forskning viser at flertallet av flokkene unngår å beite i områder nærmere enn 2 til 4 km fra hytteområder. Det bygges om lag 1000 nye hytter hvert år i eller i tilknytning til samiske reindriftsområder i Norge, som følgelig medfører tap av beiteland.
Omfang og lokalisering av hyttebygging avgjøres av kommuneplanprosesser i den enkelte kommune og fastlegges i kommuneplanens arealdel. I disse planprosessene skal reindriftas representanter høres, for å sikre at planlagt hyttebygging ikke er til skade for reindrifta i området. I praksis fungerer dette ikke alltid slik det skal verken med hensyn til kommunenes involvering av reindriftsinteressene eller reindriftsinteressenes deltakelse i planprosessene. Dette gjelder både for kommuneplanprosesser for hele kommuner og for reguleringsplanprosesser for konkrete hyttefelt.
Vi har studert dette både i en oversiktsanalyse over hele det området hvor det drives samisk reindrift (om lag 40% av landets areal), og i nærmere studier av tre områder (inkludert fem kommuner). Den nasjonale oversiktsanalysen viser at de fleste kommuneplanprosesser og konkrete reguleringsplanprosesser ender med kompromissløsninger som åpner for mye hyttebygging. I tillegg har en del kommuner svært liberal dispensasjonspraksis og tillater mye hyttebygging i områder som i kommuneplanens arealdel ikke er åpen for slik utbygging. Resultatet av dette er både mer hyttebygging og et mer spredt hyttebyggingsmønster enn reindrifta ønsker.
Studiene i de tre utvalgte områdene viser at planprosessene i stor grad er forhandlingsprosesser mellom motstridende interesser; kommunene ønsker bygging da det gir arbeid og inntekt for lokalbefolkningen, mens reindriftsinteressene ikke ønsker bygging og aktivitet som forstyrrer reinflokkene. Deltakelsen i planprosessene kan derfor fra begge parter ofte være strategisk, og tilliten mellom partene er tilsvarende lav, noe som vanskeliggjør kommunikasjon og dialog mellom partene. Ulike meninger om konsekvensene av hyttebygging internt i reindrifta og mellom lokale representanter for reinbeitedistrikt og regionale representanter for reinbeiteområder vanskeliggjør planleggingen for kommunene. På den andre siden er kommunenes manglende forståelse for reindriftas behov for store uforstyrra beitearealer et klart hinder for å nå fram til gode kompromissløsninger som reindrifta også kan leve med i et langsiktig perspektiv. I og med at reindrifta i de fleste kommuner utgjør en marginal økonomisk interesse, blir ikke reindriftas interesser prioritert av kommunene.

Preconditions for the reindeer husbandry in a progressing climate change

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The reindeer husbandry area in Sweden will be affected by climate change on several levels. Autumn, winter and spring will be especially affected as the conditions during these seasons are strongly influenced by temperatures around 0 °C, while changes during summer will be considerably less dramatic for reindeer husbandry. On an 80-year perspective, the snow season is expected to be shortened with 1 to 2 months according to IPCC's climate scenario B2 (SRES), together with the global climate model ECHAM and SMHI's regional models RCAO/RCA3. The average winter temperature is expected to increase by 4 to 6 °C and the number of days with frost to decrease by 30 to 50 days. The precipitation will increase during autumn, winter and spring, mostly as rain. Summers will be 2 to 2.5 °C warmer, but the precipitation scenarios for summers are more geographically varied and the wind scenarios are relatively unsure.
Local scenarios for the husbandry are very complex and difficult to foresee as the reindeer husbandry area in Sweden is very heterogeneous and the husbandry differs in the different herding districts, as well as, the climate scenarios are dependent on geography, season and biotope. Therefore, a questionnaire study, including climate scenario maps with weather variables relevant to the reindeer husbandry, was carried out. The questionnaire was given to reindeer herders from all parts of the Swedish reindeer herding area and they were asked to give personal reflections and predictions of the local conditions and how it would affect their local reindeer husbandry and prerequisites. In addition, there was room for the respondents to define local requirements for a continuously sustainable husbandry based on the presumed changes. They were also asked to rank and quantify the importance of different sources of disturbances of today and of the future in relation to climate change.
The respondents reported both presumed positive and negative partial and summarised effects of climate change. Any organized local planning efforts do not seem to have been put into practice in the husbandry units. Concerns among the respondents regarding climate change and reindeer husbandry were obvious, but in relation to other threats to reindeer husbandry, such as forest cultivation, wind power plants, tourism and large carnivores, the climate change issues do not seem to be the biggest source of concern for reindeer husbandry in Sweden.

Renskötselns förutsättningar i en pågående klimatförändring

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Renskötselområdet i Sverige förväntas bli påverkat av klimatförändringarna på flera sätt och nivåer. Höst, vinter och vår kommer att förändras betydligt då förhållandena under dessa årstider starkt påverkas av temperaturer vid och omkring 0 °C, medan förändringarna under sommaren blir betydligt mindre dramatiska sett ur renskötselns perspektiv. Enligt IPCC:s klimatscenario B2 (SRES), den globala klimatmodellen ECHAM och SMHI:s regionala modeller RCAO/RCA3 förväntas snösäsongen på 80 års sikt förkortas med mellan en och två månader. Vinterns medeltemperatur förväntas öka med 4 till 6 °C och antalet frostdagar minska med mellan 30 og 50 dagar. Nederbörden kommer även att öka under höst, vinter och vår, mestadels i form av regn. Sommaren kommer att bli 2 till 2,5 °C varmare, men scenariot för nederbörd på sommaren är mer geografiskt varierat och vindscenarierna på årsbasis relativt osäkra.
Lokala scenarier är mycket komplexa och svåra att förutsäga då renskötselområdet i Sverige är heterogent och renskötseln i de olika samebyarna skiljer sig åt. Klimatscenarierna är dessutom beroende på geografi, säsong och biotop. En informationsenkät innehållande klimatscenariekartor med för renskötseln relevanta vädervariabler skickades ut till personer involverade i renskötseln. I denna ombads de ge personliga reflektioner och förutsägelser över vad klimatförändringen skulle kunna innebära för deras lokala renskötsel och förhållanden. Det gavs utrymme för de svarande att identifiera behov för att kunna fortsätta att bedriva en livskraftig renskötsel under kommande förändringar i klimat och förutsättningar. Man ombads även att rangordna och kvantifieras allvarligheten av olika störningar idag och på sikt under en pågående klimatförändring.
Både positiva och negativa effekter av klimatförändringen rapporterades av enkätdeltagarna. Några lokala organiserade planeringsarbeten med anledning av klimatförändringarna verkar inte ha startats inom renskötseln och i samebyarna. Frågor om att klimateffekterna på renskötseln kommer att bli påtagliga är tydliga i enkätsvaren, men i relation till andra hot mot skötseln, såsom skogskötsel, vindkraft, turism och rovdjur, förefaller klimatförändringarna inte vara det största orosmomentet inom renskötseln.

Large-scale productivity determinants of reindeer husbandry in Sweden

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The productivity of the reindeer industry in the 51 herding districts in Sweden is affected by a large amount of factors on different geographical and temporal scales. Combinations of factors characterizing the environmental conditions for reindeer husbandry were identified and showed to be strongly correlated with variations in productivity, both between herding districts and between years. Productivities were described by estimated herd growth rates and carcass condition of slaughtered adult females and calves. These dependent productivity variables were related to the environmental independent variables using multiple linear regression and structural equation models (SEM). The independent variables were either considered as stable (e.g. topography, vegetation and infrastructure) or temporally changing (e.g. season lengths, weather events, disturbances and animal slaughter strategies). The most relevant independent variables identified were used in a cluster analysis to suggest a grouping of herding districts. Larger variation in productivity was found between herding districts than between years. Different variables were found to be important for between-district and within-district variations, respectively. Season lengths and animal densities were found noteworthy at both levels of variation. Other relevant variables found were ruggedness, snow condition, predicted harassing insect activity, supplementary feeding, proportion of calfs in slaughter and previous-year animal condition. Snow precipitation, predicted ice-crust formation and forage quality were presumed to be relevant for reindeer productivity, but were not found to have large impacts on productivity at this scale. These factors may have been neutralized or mitigated by husbandry measures, statistically included and thereby explained by other variables with strong effects on productivity, such as animal density variables. Several of the variables that were found to be important for productivity are correlated with climate and weather and therefore predicted to be central in a climatic change context.

Vilka storskaliga faktorer påverkar renskötselns produktivitet i Sverige?

Renskötselns produktivitet i Sveriges 51 samebyar påverkas av många olika faktorer på flera olika skalor. Olika geografiska och tidsberoende faktorkombinationer identifierades och visade sig starkt korrelerade med variationer i produktivitet i renskötseln både mellan samebyar och mellan år. Produktiviteten definierades som skattad hjordtillväxt och slaktdjurens kondition mätt på slaktkroppar av vajor och kalvar. Dessa produktivitetssvariabler relaterades till miljövariabler som delades upp i stabila (t.ex. topografi, vegetation och infrastruktur) respektive variabler varierande över tiden (t.ex. säsongslängder, väderhändelser, störningar och slaktstrategier). Variablerna analyserades med hjälp av stegvisa multipla linjära regressionsmodeller och strukturella ekvationsmodeller (SEM).
De mest relevanta variablerna identifierades och inkluderades i en klusteranalys för att gruppera jämförbara samebyar. Större variation i produktivitet hittades mellan byar än mellan år. Olika variabler var relevanta mellan byar och mellan år. Säsonglängder och djurtäthet var relevanta både mellan byar och mellan år. Andra relevanta variabler såsom markens brutenhet, snöförhållanden, störande insekter, stödutfodring, kalvslaktsandel och djurs kondition föregående år var relevanta endast för endera av dessa. Snöfall, skare och beteskvalitet antogs vara viktiga variabler för renproduktiviteten men visade sig i denna storskaliga undersökning inte förklara mycket av variationen. Dessa variabler kan ha upphävts eller motverkats av skötselåtgärder och därmed vara inlemmade i andra mer variationsförklarande variabler såsom t.ex. djurtäthet. Flera av de mest relevanta variablerna är kopplade till klimat och därmed bidrar till att klimatförändringen påverkar renskötselns produktivitet.

The symbolic capital of reindeer husbandry: The importance of a large herd

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A little understood theme inside reindeer husbandry related research is the individual reindeer number set by each reindeer herder. A maximizing strategy can be viewed as a general practice among reindeer herders and also among other pastoralists, but a contemporary understanding of such behaviour and the structures supporting it is currently lacking. It is on this research problem my presentation will focus and the presentation is also based on fieldwork that has been conducted in northern Norway, Sweden and Finland.
In the preliminary results, a clear controversy emerges. In the reindeer husbandry field and by the state authorities, a high reindeer number is rewarded and not sanctioned. This is in stark controversy with the official reindeer reduction policies promoted especially by the states of Norway and Finland. A high reindeer number 1) results in a higher economic yield in combination with state subsidies, 2) provides more power inside the district, 3) provides security against an uncertain future, 4) gives a higher social status inside the local community and 5) it gives a better chance for recruitment. In addition, 6) the process of positioning must be highlighted. This means to employ the strategy of herd expansion in anticipation of distribution of rights such as individual transferable quotas of reindeer (Finland) or the division of the common pastures among the siidas or reindeer groups (Norway).

Symbolkapital i reindriften – tryggheten med å ha en stor reinflokk

Et lite forstått tema innenfor reindriftsforskningen er hvordan reintallet til den individuelle reindriftsutøver blir fastsatt og hvorfor det er viktig å eie en stor reinflokk. En maksimeringsstrategi kan bli sett på som en generell strategi hos de fleste pastoralister, inkl. reindriftsutøvere, men en forståelse av denne strategien og det rammeverket som støtter den, mangler. Dette er problematikken som denne presentasjonen vil prøve å utdype. Feltarbeid er utført i flere samiske reinbeitedistrikter i Norge, Finland og Sverige. I de preliminære resultatene fra feltarbeidet finner man kontroversielle uttalelser angående reintall. Innenfor reindriftsnæringen og innenfor det statlige forvaltningssystemet blir et høyt reintall belønnet i stedet for sanksjonert. Dette er i sterk kontrast til den statlige politikken som prøver å få både reintallet og antall reineiere redusert. Et høyt reintall 1) gir blant annet et høyere økonomisk resultat i sammenheng med subsidier/kompensasjoner, 2) gir mer makt innenfor distriktet og mellom distriktene, 3) gir mer sikkerhet mot uforutsigbare forandringer, 4) gir høyere sosial status i lokalsamfunnet og 5) gir bedre mulighet for rekruttering. I tillegg 6) så må prosessene rundt posisjonering bli understreket. Posisjonering i reindriftsnæringen skjer ved at reineiere prøver å maksimere sitt reintall i vente på at rettigheter til beite og reintall vil bli individuelt fordelt. Alle disse prosessene støtter det å eie en stor reinflokk.

Cervid herpesvirus 2 causes respiratory and fetal infections in semi-domesticated reindeer

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Viruses from the subfamily *Alphaherpesvirinae* are known to infect and cause disease in several ruminant species becoming a lifelong infection as they have the capability to establish latency in sensory ganglions. Of these bovine herpesvirus type 1 (BoHV-1), causing the diseases Infectious Bovine Rhinotracheitis (IBR), Infectious Pustular Vulvovaginitis (IPV) as well as abortion and weak born calves, has been widely described given its impact on animal health and husbandry worldwide. BoHV-1 and other viruses belonging to the genus *Varicellovirus,* are known to cross-react serologically and have been isolated from semi-domesticated and wildlife ruminant species such as cervid herpesvirus 2 (CvHV-2) from reindeer (*Rangifer tarandus tarandus*) in Finland and Sweden. Despite serological evidence of the presence of this virus in reindeer in Finnmark County, Norway, it has never been isolated in Norway and little information is available regarding its transmission, latency and potential to cause abortion and disease. The mortality of reindeer in Finnmark in 2006 was 37% during the reindeer herding year of 2005-2006 and 11% of mortalities remain of unknown etiology. To address the possibility that CvHV-2 infection may affect the respiratory system and in part explain abortions and the relatively high mortality of reindeer calves during their first year of life, tissue samples were obtained from reindeer and reindeer fetuses at slaughterhouses in Finnmark County during the period 2004 to 2006. Sampling was conducted from animals representing 10 of the 14 reindeer districts of Finnmark County that had been screened in an alphaherpesvirus serosurvey in 2004 to 2006. That serosurvey identified a significant higher seroprevalence in animals with high carcass mass (adults) compared to animals with low carcass mass (calves). A nested pan-alphaherpesvirus PCR targeting the highly conserved UL27 gene (glycoprotein B) was used to amplify viral DNA. The amplicon sequences were identical or differed just in one nucleotide when compared to the CvHV-2 isolate obtained in 1992 from a Finnish reindeer (Salla 82). The findings of CvHV-2 DNA in trigeminal ganglia (27 of 143), nasal swabs (5 of 75) and fetal tissues (12 of 48), of the latter including lung, liver, spleen and blood samples, indicate that CvHV-2 infection is endemic in this reindeer population, that the virus is transmitted horizontally by the respiratory route establishing latency in the trigeminal ganglion, and that virus is transmitted vertically to the fetus through the placenta. This virus may thus have a potential impact on reindeer health as well as reproductive success. Reindeer are a central key species to the northern boreal and sub-arctic ecosystems and of outmost economical and social importance for the indigenous peoples across Fenno-Scandia and other northern regions. The study of diseases, that may have an impact on sustainability and husbandry, should have a central place in management plans and future scientific research and further studies should focus on the reproductive impact of CvHV-2 infection in reindeer.

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Cervid herpesvirus 2 forårsaker infeksjoner i luftveiene og overføres til foster hos tamrein

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Virus i underfamilien *Alphaherpesvirinae* forårsaker infeksjoner og sjukdom hos mange drøvtyggerarter. De etablerer latens i nerveganglier og gir en livslang infeksjon. Av disse virusartene er Bovint herpesvirus type 1 (BoHV-1), som forårsaker sjukdommene Infeksiøs rhinotrakeitt (IBR), Infeksiøs pustulær vulvovaginitt (IPV), abort og svakfødte kalver, best beskrevet på grunn av betydningen for storfe verden over. BoHV-1 og andre virus tilhørende genus *Varicellovirus*, er kjent for å kryssreagere serologisk og har blitt isolert fra tamrein og ville drøvtyggere, som cervid herpesvirus 2 (CvHV-2) fra reinsdyr (*Rangifer tarandus tarandus*) i Finland og Sverige. Det er kjent fra tidligere serologiske undersøkelser at dette viruset fines hos reinsdyr i Finnmark fylke (Norge) men viruset har aldri blitt isolert fra norsk rein, og det er lite kunnskap om hvordan det overføres mellom dyrene, hvor viruset eventuelt etablerer latens, og dets potensial til å forårsake abort og sjukdom. For reindriftsåret 2005-2006 ble det registrert et tap av dyr på 37% i Finnmark hvorav 11% var av ukjente årsaker. For å undersøke muligheten for at infeksjoner med CvHV-2 kan være assosiert med luftveisinfeksjoner, aborter og en relativt høy dødelighet av kalver under første leveår, samlet vi blod og vevsprøver fra reinsdyr og fostre fra slakterier i Finnmark i perioden 2004-2006. Det ble tatt prøver fra dyr fra 10 av de 14 reinbeitedistriktene i Finnmark som var representert i en tidligere serologisk undersøkelse for antistoffer mot alphaherpesvirus (2004-2006). I den serologiske undersøkelsen ble det funnet en klart høyere seroprevalens hos dyr med høy kroppsvekt (voksne) i forhold til dyr med liten kroppsvekt (kalver). Vevsprøvene ble testet ved hjelp av en polymerase kjedereaksjonstest (nested pan-alphaherpesvirus PCR) for påvisning av virus-DNA (UL27-genet; Glycoprotein B). Sekvensering av PCR-produktet viste at virus-DNA i vevsprøvene var identiske med eller hadde kun én nukleotidforskjell fra CvHV-2-virsuet som ble isolert fra finsk reinsdyr i 1982 (Salla 82). Funn av virus-DNA i nerveganglier (27 av 143), nesesvaberprøver (5 av 75) og i prøver fra 12 av 48 fostre (lunge, lever, milt og blod) indikerer at dette viruset (CvHV-2) er endemisk i denne reinsdyrpopulasjonen, at viruset overføres horisontalt via luftveiene og etablerer latens i nerveganglier (*Ganglion trigeminale*), samt at viruset kan overføres vertikalt til foster over placenta. En kan derfor ikke utelukke at dette viruset kan ha en betydning for helse og reproduksjon hos reinsdyr. Reindrift spiller en sentral rolle i de nordlig boreale og subarktiske økosystemer og har en stor økonomisk og sosial betydning urbefolkningsgrupper i Fenno-Scandia og andre nordlige områder. Forskning på reinsdyrsjukdommer som kan ha en betydning i forhold til en lønnsom og bærekraftig reindrift bør ha en sentral rolle i forvaltningsplaner og utvikling av reindrifta. Videre forskning på reinsjukdommer bør blant annet omfatte betydningen av CvHV-2-infeksjoner i forhold til abort og sjukdom.

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Reindeer husbandry problems in Inner Mongolia, China

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Extended abstract: The last hunting tribe in Inner Mongolia, the Yakute tribe, also called the Reindeer tribe, is one of the three branches of the Evenki ethnic group living deep in the Greater Xingan Mountains, the largest forest area in China. They are descendants of reindeer herding people who emigrated from the Lake Baikal area of the Lena basin about 200 years ago. The once-nomadic Evenki tribe with a population of about 170 settled in and around the village of Aoluguya in the northernmost part of Genhe in 1965. Today there are ca 500 inhabitants living in the village, 230 of them Evenki hunters. In 1976, there were totally 995 reindeer in China, whereof 810 adults; 422 males and 388 females. The rest were juveniles; 72 males and 73 females. The female reindeer were milked and males were used as transport animals. In addition the velvet antlers of reindeer were utilised (Yi-Ching, 1983). Today, houses with modern facilities have been built to 62 reindeer herding families in the western suburbs of Genhe. Altogether, they have only about 600 reindeer in five different herds. Herd 1 is the original reindeer herd since 1949, and it is the biggest herd in China, located about 280 km from Genhe to the north. The herd which consists of about 300 reindeer is owned by 10 families, and 10 people live with the herd. No slaughtering of reindeer takes place, and only old and suffering reindeer are killed for animal welfare reasons. Then the carcasses are sold. Last year dogs and bears killed one and eight reindeer calves, respectively. There are more than 60% males in the herd. Antlers are removed during summer. Herd 2 is located about 180 km from Genhe and consists of about 45 reindeer belonging to one herder family. This family had about 100 reindeer in 1990 but only 30 reindeer in 2003 when the herd was moved to the current location. The gender ratio is different from other herds; 28 of the 45 animals are females. In 2007, the herd produced 13 calves, of which eight were females. Herd 3 is 80 km from Genhe, and three families live with this herd. They have ca 140 reindeer, ca 60% males and 40% females. Equal numbers of male and female calves were born. Antlers are cut, but no reindeer have been slaughtered recently. The herd has decreased but no predator problems are reported in this area. Herd 4 grazes 35 km from Genhe; herded by men of three families, women and children stay in Genhe. About 70 reindeer, 20 females and 11 calves, are living in this area. Ten years ago, 30 reindeer were imported from Russia. During the last year, wolves killed 6 calves. A couple of years ago, some old and sick reindeer were slaughtered. The herd is collected to the camp with salt and yellow soy beans. Winter fodder consists almost exclusively of lichen. Antlers of all animals, apart from reindeer calves, are removed during summer. Herd 5 stays about 30 km from Genhe. There are ca 40 reindeer herded by one family. The population structure and pasture situation is regarded as similar to herd 3.
Altogether, parasites appear to be similar to other reindeer herding areas of the world, and yearly anti-parasitic treatments control them effectively. No signs of brucellosis have been noticed in Chinese reindeer, but *Brucella* sero-reactive animals were seen in Mongolian Tsaatan reindeer (Haigh *et al*., 2006). Despite the small number of individuals of the Genhe reindeer, and their isolation from other herds of reindeer, the analyses of genetic variability in 14 micro satellite loci revealed neither signs of reduced genetic variability nor any ongoing inbreeding. In Mongolian and Siberian reindeer, where populations have also decreased, using different genetic analytical methods, slightly different results have appeared (Kol *et al*., 2006; Røed *et al*., 2006, 2008). Currently, reindeer herding is mostly based on velvet antler trade, which has caused the distortion of sex structure of the herds (Nieminen & Oksanen, 2008). The lack of tradition in eating reindeer meat may be a major problem of Chinese reindeer husbandry but it is generation shifts in the herder families which are considered to be the major problem; their children are not interested in living a traditional Evenki life. Infrastructure, such as road network and services, which might be used for tourism purposes, is generally non-existing.

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Porotalouden ongelmat Sisä-Mongoliassa, Kiinassa

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Viimeinen metsästäjäheimo, jakuuttiheimo, kutsuttu myös poroheimoksi, on yksi kolmesta evenkien etnisen ryhmän haarasta, joka elää Kiinan laajimmalla metsäalueella, suurilla Xingan vuorilla. He ovat venäläisen poronhoitajakansan jälkeläisiä, ja muuttivat alueelle Baikal-järven ja Lena-joen alueilta noin 200 vuotta sitten. Aikaisemmin paimentolaiselämää viettäneet noin 170 evenkiä asettuivat vuonna 1965 Genhen alueen pohjoisimpaan osaan Aoluguyan kylän ympärille. Nykyään kylässä on noin 500 asukasta, joista 230 on metsästäviä evenkejä. Vuonna 1976 Kiinassa oli yhteensä 995 poroa. Aikuisia poroja oli 810, niistä 422 urosta ja 388 naarasta. Nuoria poroja oli 145, niistä 72 urosta ja 73 naarasta. Vaadinporoja lypsettiin, urosporoja käytettiin vetoeläiminä. Porojen kasvavia verisarvia tuolloin myös hyödynnettiin (Yi-Ching, 1983). Nykyään 62 poronhoitajaperheelle on rakennettu nykyaikaiset talot Genhen läntiselle esikaupunkialueelle. Yhteensä heillä on vain noin 600 poroa viidessä eri laumassa. Lauma 1 on alkuperäinen lauma vuodelta 1949, ja se on Kiinan suurin porolauma. Lauma on noin 280 km Genhestä pohjoiseen, ja siellä on 10 perheellä noin 300 poroa. Vain 10 ihmistä hoitaa näitä poroja. Poroja ei teurasteta, ainoastaan vanhoja ja sairaita poroja tapetaan ja lihat myydään. Vuosi sitten metsästyskoirat tappoivat yhden ja karhut 8 vasaa. Porojen sarvet katkotaan kesällä. Lauma 2 on noin 180 Genhestä ja käsittää noin 45 poroa. Laumaa hoitaa yksi perhe, ja sillä oli vuonna 1990 vielä noin 100 poroa, mutta vuonna 2003 vain 30 poroa perheen muuttaessa nykyiselle alueelle. Lauman sukupuolirakenne on muista poikkeava; 45 porosta naaraita on 28. Vuonna 2007 laumaan syntyi 13 vasaa, joista naaraita oli 8. Lauma 3 on noin 80 km Genhestä, ja sitä hoitaa kolme perhettä. Laumassa on noin 140 poroa, niistä noin 60% on uroksia. Uros- ja naarasvasoja syntyy yhtä paljon. Sarvet katkotaan, mutta poroja ei nykyään teurasteta. Porojen määrä on vähentynyt, vaikka alueella ei ole peto-ongelmaa. Lauma 4 on noin 35 km Genhestä, ja sitä hoitavat kolmen perheen miehet, vaimot ja lapset asuvat Genhessä. Laumassa on noin 70 poroa, niistä 20 on vaadinta ja 11 vasaa. Noin 10 vuotta sitten alueelle tuotiin 30 uutta poroa Venäjältä. Viime vuonna sudet tappoivat laumasta 6 vasaa. Muutamia vuosia sitten joitakin vanhoja ja sairaita poroja tapettiin. Lauma kootaan kämppäalueelle suolan ja soijajauhon avulla. Porojen talviravinto näyttää koostuvan lähes kokonaan jäkälistä. Vasoja lukuun ottamatta kaikkien muiden porojen sarvet katkotaan myyntiin kesällä. Lauma 5 on noin 30 km Genhestä. Lauman noin 40 poroa hoitaa yksi perhe. Lauman rakenne ja laitumet ovat kuin laumassa 3. Yleensä alueen poroilla on samoja loisia kuin muuallakin poronhoitoalueella, ja niitä vastaan käytetään tavallisesti vuosittain tehokasta loistorjuntaa. Kiinan poroissa ei havaittu merkkejä bruselloosista, vaikka tällaisia sairaita poroja on tavattu Mongoliassa Tsaatan heimon poroilla (Haigh ym. 2006). Pienestä poromäärästä ja sen eristäytyneistä laumoista huolimatta 14 mikrosatelliittilokuksen vaihtelevuus ei osoittanut merkkejä vähentyneestä geneettisestä vaihtelevuudesta eikä sisäsiitoksesta. Mongolian ja Siperian alueilla, joissa myös poromäärät ovat vähentyneet, eri geneettiset tutkimukset ovat antaneet hieman poikkeavia tuloksia (Kol ym., 2006; Røed ym., 2006, 2008). Kiinan poronhoidon suurimpana ongelma on perinteen ja poronlihan käytön puuttuminen. Nykyään poronhoito perustuukin pääasiassa verisarvituotantoon, joka on aiheuttanut myös porojen vääristyneen sukupuolirakenteen (Nieminen & Oksanen, 2008). Myös poronomistajien sukupolvenvaihdos on suuri ongelma, sillä jälkeläiset eivät ole enää kiinnostuneita evenkien perinteellisestä elämäntavasta. Alueelta puuttuvat myös turismin kehittämisen kannalta tärkeät palvelut ja hyvä tieverkosto.

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The impact of large carnivores on the mortality of reindeer in Kuusamo area

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Predators have caused increased losses in the Finnish semidomesticated reindeer stock during last years, especially in the southeastern regions of Kainuu and Kuusamo, and mainly due to expanding wolf population in Kainuu, south of the reindeer management area. In addition to the impact of wolves, also brown bears cause problems in the reindeer-herding districts situating by the Russian border. The high mobility of bears and wolves, locally varying rates of predation, as well as intrinsic and extrinsic factors affecting reindeer population constitute a challenging field for studying the impact of large carnivores on the reindeer population dynamics and productivity. However, such studies are necessary in assessing the role of predation in calf losses and the feasibility of the current and planned compensation regimes for predator-killed reindeer.

As part of a large calf mortality study (>4000 calves radio-collared from 1997 to 2006), carried out by Finnish Game and Fisheries Research Institute, we studied the impact of large carnivores on calf mortality in Kuusamo region. During six years (from 1999 to 2004) we studied survival of a total of 580 calves in the reindeer-herding district of Oivanki. From 2004 to 2006, we moved our focus to the reindeer-herding district of Kallioluoma, the southern neighbour of Oivanki, where we radio-collared in total 687 calves. Most of the calves were marked already at the age of 1 to 3 days in calving corrals. The survival of calves was monitored from the calving in May until winter round-ups in October-January. In addition to calf mortality, also information on the distribution of predators, the loss of adult reindeer and the effect on the productivity of reindeer stock was obtained. The rate, timing and causes of mortality (predation *contra* other causes) as well as underlying factors affecting survival of the study calves were assessed.

During six years we found in total 42 radio-collared calves dead in Oivanki by the end of October whereas in Kallioluoma we found 114 dead calves during three years only, of which most (111) in 2005-06. In Kallioluoma, we monitored the survival of marked calves until mid-January, by which an additional 28 calves died. The results from Kuusamo reveal the great annual variation in mortality and predation pressure. In 2000-01 few bears caused great losses among marked calves in Oivanki, and total annual mortality varied from 22% to 23%, while in 2002-04 annual mortality varied only from 0% to 5%. In 2000-01 predation by bears was on average 4-6% of calves plus 15% of potentially bear-killed calves (hardly any remains left after been eaten by a bear). In contrast, from 2002 to 2004 only 2% of calves were eaten by bears. Other carnivores (lynx, wolf and wolverine) killed each only one study calf in Oivanki. In a neighbouring district of Kallioluoma the situation in calf loss and predation was different. In 2004, only three calves out of 100 radio-collared were found dead, but in 2005-06 we found in total 139 dead calves. Mortality reached about 29% by the end of October and exceeded 40% by mid-January. Wolf predation comprised on average 18% of all radio-collared calves while the total rate of all predation was at least 21% (potentially even 25%). The adult females found dead (n=45) comprised altogether 13% and those killed by wolves (n=32) 9% of all the females that gave birth in the calving corrals. In addition to those females found dead, 21 females (6%) were lost. Thus, many calves (nearly 10%) were orphaned.

Suurpetojen vaikutus porojen kuolleisuuteen Kuusamon alueella

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Petoeläimet ovat aiheuttaneet viime vuosina yhä suurempia ja vuosittain lisääntyviä menetyksiä Suomen poronhoitoalueen porokarjassa. Suuri osa petojen aiheuttamista tappioista kohdentuu poronhoitoalueen kaakkoisosaan, Kainuun ja Kuusamon alueelle, ja yhtenä merkittävänä tekijänä on Venäjän rajan lisäksi poronhoitoalueen eteläpuolella vakiintunut ja vahvistunut susikanta. Susien lisäksi myös karhut aiheuttavat ongelmia poronhoidolle, erityisesti Venäjän rajan läheisyydessä. Suurpetojen suuri liikkuvuus, paikallisesti vaihteleva saalistuspaine, kuten myös porokantaan vaikuttavat sisäiset ja muut ulkoiset tekijät muodostavat haastavan tutkimusasetelman tutkittaessa petojen vaikutusta porokannan populaatiodynamiikkaan ja tuottavuuteen. Tutkimusta kuitenkin tarvitaan, jotta pystytään määrittelemään esimerkiksi petoeläinten vaikutus vasojen ja aikuisten porojen hävikkiin, sekä perusteet nykyisille ja uusille korvausjärjestelmille.
Osana laajaa Riista- ja kalatalouden tutkimuslaitoksen Suomen poronhoitoalueella toteuttamaa vasakuolleisuustutkimusta (yhteensä yli 4000 vasaa merkittiin ns. kuolevuusradiolähettimillä vuosina 1997-2006) keskityimme Kuusamon tutkimusalueilla erityisesti suurpetojen vaikutukseen vasahävikin ja –tuoton näkökulmasta. Oivangin paliskunnassa seurasimme kuuden vuoden (1999-2004) aikana yhteensä 580 radiopannoitetun vasan selviytymistä ja vastaavasti Oivangin eteläpuolella Kallioluoman paliskunnassa kolmen vuoden (2004-06) aikana yhteensä 687 vasan kohtaloita. Molempien paliskuntien tutkimusalueet sijoittuivat paliskuntien itäosiin, muutaman kymmenen kilometrin sisälle Venäjän rajaan nähden. Vasat merkittiin pääosin 1-3 vuorokauden ikäisinä vasotustarhoissa, mutta lisää vasoja radiopannoitettiin myös keskikesän vasanmerkinnässä. Seurasimme vasojen selviytymistä läpi kesän ja syksyn vasonnasta aina alkutalven (loka-tammikuu) poroerotuksiin asti. Vasojen kuolleisuuden ja kuolinsyiden lisäksi seurasimme myös alueiden petotilannetta sekä aikuisten siitosporojen hävikkiä. Vasahävikin osalta tarkasteltiin sen suuruutta, ajoittumista ja kuolinsyitä (pedot vs. muut) sekä vasojen selviytymisen taustalla olevia tekijöitä.
Kuuden vuoden kuluessa löysimme Oivangin tutkimusalueilta vasonnan ja lokakuun lopun välillä yhteensä 42 kuollutta radiopantavasaa. Kallioluomassa löysimme vastaavasti yhteensä 114 kuollutta vasaa kolmessa vuodessa, joista suurin osa (111) vuosina 2005-06. Kallioluomassa seurasimme radiopantavasojen kuolleisuutta tammikuun loppuun asti ja löysimme marras-tammikuun aikana lisäksi 28 kuollutta vasaa. Tulokset osoittavat, että vasakuolleisuudessa ja petojen aiheuttamassa saalistuspaineessa on huomattavia vuotuisia eroja. Vuosina 2000-01 muutama karhu aiheutti suurta hävikkiä Oivangin itäosan vasakarjassa touko-kesäkuussa ja radiopantavasojen kokonaiskuolleisuus oli 22-23%. Vuosina 2002-04 kuolleisuus oli vastaavasti vain 0-5%. Vuosina 2000-01 karhujen aiheuttama kuolleisuus oli vähintään 4-6%, mutta lisäksi 15% vasoista oli karhun syömiä (näistä vasoista ei ollut jäljellä juuri mitään kuolinsyyn varmistamiseksi). Vuosina 2002-04 vain 2% vasoista todettiin karhun syömiksi. Muut suurpedot (ilves, ahma ja susi) tappoivat Oivangissa kukin vain yhden radiopantavasan. Oivangin eteläpuolella Kallioluomassa tilanne vasakuolleisuudessa ja petopaineessa oli varsin toisenlainen. Vuonna 2004 löysimme sadasta radiopannoitetusta vasasta vain kolme kuolleena, mutta vuosina 2005-06 löysimme maastosta yhteensä peräti 139 kuollutta vasaa. Vuosina 2005-06 kuolleisuus oli lokakuun loppuun mennessä 28-29% ja ylitti 40%:n rajan tammikuun puoli-välissä. Susien aiheuttama kuolleisuus oli keskimäärin 18% radiopantavasoista kun kaikki pedot yhteensä muodostivat vähintään 21%:n kuolleisuuden (todennäköisesti 25%). Yhteensä 13% vaatimista (*n*=45), jotka vasoivat vasotustarhoissa, löytyi kuolleena, ja susien tappamia näistä oli 32. Löytyneiden kuolleiden vaatimien lisäksi 21 vaadinta (6%) jäi hukkaan. Vaadinten kuolleisuuden vuoksi useat vasat olivat alkutalven poroerotuksessa orpona.

From conflict to co-management – The small-game-hunting in the region of Ammarnäs

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In the fall 2003, the small-game-hunting in the mountain region of Ammarnäs can be described as a chaotic hunt; although the hunters got theirs quotas full they did not care about that. It was the hunting itself that was important, and consequently there were dead grouses seen "everywhere" in the mountains; dogs were running after the reindeer, herds were spread over large areas in a short time, and the gathering work to get the reindeer to slaughter were disturbed and destroyed. The situation was totally out of control. Therefore local people reacted towards this untenable situation with unregulated small-game-hunt. They demanded that they should have the right to organize the hunt, since they had the knowledge to take care of all different interests that exist in the mountain-region.
The peoples' common-pool resource (CPR) was threatened by an out-coming group's behaviour, and the locals both Sami and non-Sami were dependent on the CPR in different ways for living in the area, some through herding and others through tourism. The local groups had in common that the mountain and its resources were the base for their economical survival and they became unified in the work against the irresponsible hunters. The goal was to have the responsibility for the small-game-hunt and organize it in a way that benefited them all, including the hunters. A working-group developed a proposal on how the small-game-hunting could be organized. The county of Västerbotten and the municipality of Sorsele were well aware of all the problems with the small-game-hunting and were favourably disposed to the working-groups proposal. From the proposal, the different interests and the authorities started to develop a new organization of small-game-hunting in the Ammarnäs region, a form of co-management evolved.

Från konflikt till samförståndslösning – Småviltsjakten i Ammarnäs

Hösten 2003, småviltsjakten i Ammarnäsfjällen urartar fullständigt. Läget då kan beskrivas som kaos, ripor och ripkycklingar är skjutna och ligger slängda hur som helst i fjällområdena. Ripjägarna struntar i att de skjutit fullt på sina kvoter, själva jakten är det väsentliga. Fågelhundar jagar renar, renhjordar sprids på stora områdena, renskötarnas samlingsarbete inför sarvslakten förstörs på några timmar. Då får ortsbefolkning, såväl icke-samer som samebymedlemmar, nog. De säger helt enkelt ifrån och lägger fram krav till myndigheterna att de innehar kunskapen för att förvalta småviltsjakten på ett genomtänkt och strukturerat sätt som tar hänsyn till alla inblandade.
Det som skedde hösten 2003 i Ammarnäsfjällen var att common-pool resource (CPR) i området var hotad. Hela befolkningen oavsett etnisk tillhörighet var beroende av den för sin överlevnad i Ammarnäs oavsett om man livnärde sig på renskötsel, turism, fiske eller hade andra företag där naturen var en grundförutsättning. De olika grupperingarna i bygden enades till följd av ett yttre hot, i det här fallet jägarnas syn på CPR:n och hur de nyttjade den. I Ammarnäs fanns det redan ett råd som arbetade för utvecklingen av bygden och de lyfte frågan om ripjakten upp på agendan. En arbetsgrupp tillsätts som består av en representant för samebyarna och en för företagarna/ ortsbefolkningen, vilka arbetar fram ett förslag om nyorganisering av småviltsjakten. Förslaget skickas till länsstyrelsen i Västerbotten och Sorsele kommun som konstaterat att ripjakten måste stramas upp så att inte 2003 års okontrollerade småviltsjakt återupprepas. Bägge instanserna var välvilligt inställda och ett gemensamt arbete för att organisera småviltsjakten tar vid. En form av samförvaltning mellan de olika parterna inleds.

Kill rates of Eurasian lynx on semi-domestic reindeer in Norway and Sweden

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It is widely recognised that predation is a major cause of mortality for domestic reindeer in the Nordic countries. However, there is considerable controversy about the extent of predation and as to which predatory species are responsible for the predation. This is particularly important for the issue of paying fair levels of compensation, an equal challenge if the system is based on paying for losses or paying for predator populations. The last two years more than 20 lynx of different age and sex classes were captured and fitted with a new type of Global Positioning System (GPS)-collars in northern Sweden and Norway. These GPS-collars allow us to receive GPS positions continuously over the GSM-net, and kill rates on reindeer were be obtained by collecting prey remains found at GPS-positions as soon as the lynx has left the area. The project has seen a continual development of methodology with respect to data sampling protocols (especially location frequency) to optimise our chances of detecting all semi-domestic reindeer killed by lynx. The results obtained so far indicate that while there is considerable variation between individuals and sexes the rates of depredation on reindeer can be very high. However, these kill rates are considerably influenced by how far the location of a lynx territory is from to the seasonal migration routes of the reindeer prey.

Drapsratene på tamrein for gaupe i Norge og Sverige

At gaupa dreper tamrein er udiskutabelt. En del av den sammensatte konflikten mellom reinnæring og gaupe går på hvor mange tamrein gaupa dreper. En full forståelse av konflikten krever studier av atferden til individuelle rovdyr. Til nå har få eller ingen studier tallfestet gaupenes drapsrater på rein gjennom hele året, sjøl om dette er viktig for utvikling av rettferdige kompensasjonssystemer. De siste to årene er mer enn 20 gauper utstyrt med en ny type GPS sendere i nordlige deler av Sverige og Norge. GPS senderne tar posisjoner ved hjelp av satellitter, og vi får tilsendt posisjonene per SMS et par ganger per uke via mobil-nettet. Gaupenes drapstakt på rein beregnes ved å gå inn i GPS-punkter gaupa har oppholdt seg i. Prosjektet er i startfasen, og innsamlingsmetodikken har blitt utviklet kontinuerlig for å kunne få best mulig estimat på antall drepte reiner. Dette gjelder særlig antall GPS posisjoner i løpet av døgnet. Så langt viser resultatene viser at gaupenes drapsrater på rein synes å være avhengig av hvor gaupereviret ligger i forhold til de sesongmessige forflytninger til reinen, og at hanngauper har de høyeste drapsratene.

Slaughter records as indicator of changes in reindeer herd condition

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We have investigated possibilities to use slaughter records and some additional carcass measures as indicators of body condition status in the reindeer herd and thereby of pasture resources in the summer ranges. Long-term fluctuations in grazing resources affect the nutritional status and production of the reindeer herd. It is important to detect changes in quality of the grazing resources as early as possible to be able to adapt the use and management of the resources to the fluctuations. Slaughter records for the years 1994-2007 including information on herding district, carcass weight, fatness and conformation classification according to the EUROP system and animal type (age class and sex of adults) were used. Linear and mixed models were used to estimate the effects of month, year, winter population density, and lag effects of previous year's body condition of slaughtered animals as well as lag effects of population density. We also used records from 696 reindeer slaughtered in the winter 2002/2003 (Olofsson *et al*., 2008) with additional recordings of calf sex, yearling or adults, reproductive status of the females and three body size measures (back, radius and jaw lengths). These data were analysed with linear models, principal component analyses (PCA) as well as structural equation models (SEM) with body condition and body size as latent variables. The results showed age and sex dependent differences between body size, carcass weight, conformation and fatness. Differentiation of animal age and sex improved the precision of models. Adjusting weight for body size also improved weight as a body condition indicator in adults. Conformation and fatness showed strong relationships with weight and body size adjusted weight and should preferably be included together with carcass weight and body size measures when estimating body condition from the carcass information. Our analysis showed that using non-invasive slaughter records is a practical and inexpensive method of estimating body condition in reindeer.

Reference

Olofsson, A., Danell, Ö., Forslund, P., & Åhman B. 2008. Approaches to estimate body condition from slaughter records in reindeer. – *Rangifer* 28 (1): 103-120.

Slaktregistreringar som indikator för förändringar i renhjordens kondition

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Vi har undersökt möjligheten att använda slaktregistreringar och några extra slaktkroppsmått som indikatorer för renhjordens konditionsstatus och därigenom för sommarbetesresurserna. Fluktuationer i betesresurserna påverkar hjordens kondition och produktion. Det är därför viktigt att upptäcka förändringar i beteskvalitén så tidigt som möjligt för att kunna anpassa användning och förvaltning av resurserna till fluktuationerna. Slaktregistreringar från åren 1994-2007 inkluderande information om sameby, slaktkroppsvikt, fett- och formklassificering enligt EUROP-systemet och djurkategori (kalv, vaja, tjur och oxe) användes. Linjära och mixade modeller användes för att skatta effekter av månad, år, populationstäthet i livhjorden, samt fördröjda effekter av tidigare års slaktkondition och populationstäthet. Vi använde också data från 696 renar som slaktades vintern 2002/2003 (Olofsson *et al.*, 2008) med extra registreringar av kalvarnas kön, åringar eller vuxna, reproduktiv status för vajor, samt tre kroppsmått (rygg-, käk-, och radiuslängd). Dessa data analyserades med linjära modeller, principalkomponentanalys (PCA), samt strukturekvationsmodeller (SEM) där kroppsstorlek och kondition var latenta variabler. Resultaten visade att renarnas ålder och kön ger skillnader i kroppsstorlek, fett- och formklassificeringen och vikt, samt att modellernas noggrannhet ökar om djuren grupperas med tanke på ålder och kön. Att korrigera slaktvikten för kroppsstorlek ökade precisionen för vikt som konditionsindikator för vuxna djur. Fett- och formklassificeringen överensstämde väl med storlekskorrigerad slaktvikt och skulle med fördel kunna inkluderas tillsammans med slaktvikt och storlek för skattning av kroppskondition från slaktkroppar. Våra analyser visar att användning av slaktregistreringar är en praktisk och billig metod för att skatta kroppskonditionen hos renhjorden.

Olofsson, A., Danell, Ö., Forslund, P., & Åhman B. 2008. Approaches to estimate body condition from slaughter records in reindeer. – *Rangifer* 28 (1): 103-120.

Lynx-wolverine interaction and predation on reindeer

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Reindeer is an important prey for both lynx and wolverine. The lynx is a more efficient predator than the wolverine and wolverines frequently use lynx-killed reindeer. Wolverine reproduction is influenced by availability of reindeer carcasses in winter. Therefore, wolverines might benefit from the presence of lynx. Furthermore, the total predation pressure from wolverine and lynx together might be lowest at a certain ratio of the two species. We used GPS-marked wolverine and lynx to estimate the lynx kill rate on reindeer and wolverine use of reindeer carcasses. There was a very large variation in lynx kill rate on reindeer among lynx individuals, seasons and area, partly dependent on the availability of reindeer. The lynx stayed at the carcass on average 2.4 ± 2.3 days. During late summer 60% of the carcasses were found and used by wolverines. There was large variation in the time of arrival of wolverine at the carcasses, sometimes the lynx had left and sometimes the lynx was still in the surroundings. Simulations of the lynx-wolverine interactions indicate that it is unlikely that the total predation pressure on reindeer from wolverine and lynx together will have a minimum at a certain ratio of the two species. The estimated wolverine predation was so much lower than the lynx predation that the wolverine use of lynx killed reindeer could not compensate for the higher lynx predation. Consequently the estimated total predation pressure was lowest in an area with only wolverine. However, from a conservation point of view the co-occurrence of wolverine and lynx might still benefit the wolverine. Furthermore, even if the estimated total predation pressure was lowest with only wolverines, reindeer management might still benefit from a mix of wolverine and lynx if the disturbance of the reindeer herd is lower when lynx kill reindeer and if availability of lynx-killed reindeer results in decreased wolverine predation.

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Interaktionen lodjur-järv och predation på ren

Renen är det viktigaste bytet för både lodjur och järvar inom renskötselområdet. Lodjuret är en effektivare jägare och järvar tycks regelbundet utnyttja lodjursdödade renar. Järvhonors reproduktion påverkas av tillgången på renkadaver under vintern. Därför är det sannolikt av positiv betydelse för järvar med förekomst av lodjur. Dessutom är det tänkbart att det totala predationstrycket från lodjur och järv på ren är som lägst vid en särskild fördelning av antalet individer av de båda arterna. Vi studerade järvar och lodjur som försetts med GPS-halsband för att studera predationstakten på ren och järvars utnyttjande av lodjursdödade renar. Vi observerade en stor variation i lodjurens predationstakt på ren, med stora skillnader mellan individer, årstid och områden, delvis beroende på tillgången på ren. Lodjuren stannade vid dödade renar 2,4 ±2,3 dagar. Under sensommaren besöktes 60% av de lodjursdödade renarna av järvar. Tiden från att renen dödades av ett lodjur till den besöktes av en järv varierade avsevärt. Simuleringar av interaktioner mellan järvar och lodjur indikerade att det är osannolikt att det totala predationstrycket på ren är som lägst vid en viss fördelning av antalet järvar och lodjur i ett område. Den beräknade järvpredationen var så mycket lägre än lodjurspredationen att järvarnas utnyttjande av lodjursdödade renar inte kunde kompensera för den högre lodjurspredationen. Följaktligen var det totala predationstrycket lägst i situationer med bara järvar och inga lodjur. Hursomhelst kan samexistens mellan järvar och lodjur sannolikt gynna järvpopulationen via en ökad tillgång på kadaver. Även om predationstrycket är lägst i en situation med bara järv kan man tänka sig att förekomst av båda arterna i samma område kan vara gynnsamt för renskötseln om störningen av renhjordar blir lägre när lodjur dödar renar och lodjurspredationen resulterar i minskad järvpredation på ren.

Use of land consolidation procedures in reindeer husbandry areas

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Land consolidation procedures have been used for a long time to facilitate rational use of pastures in farming areas. For Sami Reindeer herders, their user rights have been considered to be of a peculiar character falling outside the provisions of The Land Consolidation Act. In 1996 there was adopted an amendment to the land consolidation act, opening for land consolidation between reindeer herders and farmers.
The regulations concerning reindeer husbandry in this act have not been much used. In the lecture, which is based on the lecturer's doctoral thesis *Rettsutgreiing og bruksordning i reindriftsområder* (*Clarifying legal relations and prescribing rules of use in reindeer husbandry areas*), Faculty of law, Tromsø university 2008, it is shown that to employ the land consolidation act for use in reindeer husbandry areas, raise problems that have not been taken into consideration by the legislator. The analyses show that land consolidation can be applied to make purposeful use of pastures in reindeer husbandry areas, by changing in laws and procedures. In such way can land consolidation procedures be employed to reduce conflicts, distribute pastures proportionally between the right holders and facilitate rational use of pastures.

Bruksordning etter jordskifteloven i reindriftsområder

Rettsutgreiing og bruksordning etter jordskifteloven har lenge vært nyttet for å skape tjenlig beitebruk i den sørnorske fjellheimen. De samiske reinbeiteområdene har ikke vært omfattet av slike ordninger. I stortingsmeldingen *En bærekraftig reindrift* fra 1992 ble det foreslått å utvide jordskifteloven til å omfatte slike områder. Dette ble en realitet i 1996.
I foredraget, som er basert på foredragsholderens doktoravhandling *Rettsutgreiing og bruksordning i reindriftsområder* (Det juridiske fakultet, Universitetet i Tromsø 2008), blir denne lovgivningen undersøkt. Det påvises at å gi jordskifteloven anvendelse på forhold mellom reineiere og bufeholdere, skaper problemer som ikke har vært overveid av lovgiver. Analysen viser imidlertid at reglene *kan* bidra til å løse konflikter og skape mer tjenlige forhold i reindriften. Slik sett kan bruksordning være et bidrag til å styrke reineiernes økonomi, og dermed også det materielle grunnlaget for samisk kultur.

Use of reindeer habitat selection models in environmental assessment

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A problem within environmental assessment in relation to reindeer husbandry can be to evaluate the value of the ranges for the reindeer herding. The purpose of this study was to investigate the possibility to use resource selection models to objectively value different parts of a reindeer herding district. Habitat selection models were estimated using either reindeer feacal pellet-group counts or positions of reindeer collected via GPS-collars as dependent variables and vegetation type, topography and distance to hiking trails as independent variables (Skarin, 2006). The fitted habitat models were then used to predict the reindeer habitat use of an area with the given habitat variables. The two data collection methods showed similar results. However, the GPS data provided more detailed information of the use during different periods of the summer than could be predicted from the pellet-group count data. From the predictions of the reindeer use of a range, different areas within a range were given values relative each other. The habitat selection models need to be further developed by including roads, infrastructure, water bodies and other barriers influencing the logistics of range use.

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Värdering av renbetesmark till hjälp i markförvaltning

Syftet med denna studie är att föreslå metoder för värdering av olika delar av en samebys marker ur resurssynpunkt baserat på renens preferenser. Förslaget går ut på att dela upp markerna i mindre områden som är homogena med avseende på olika faktorer som påverkar renens preferens för markerna baserat på habitatanvändningsmodeller Sådan har tidigare skattats av Skarin (2006) på grundval av spillningsinventeringar resp data från GPS-utrustade renar. Beroende på delområdenas karaktär ges de olika värdetal, som i relation till värdetal för andra delområden inom betesområdet indikerar områdets relativa betydelse eller värde som betesmark. För kalibrering av värdeskalor behövs verkliga data, som avspeglar renars nyttjande av olika typer av marker. I framtida tillämpningar behöver värderingarna kompletteras med andra aspekter, t.ex. olika typer av barriärer som påverkar möjligheterna till åtkomst av markerna

Reindeer husbandry adaptation strategies for loss of grazing land and climate change

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In the last decade, northern Norway has received increased economic and political interest due to the opening of petroleum development in the Barents Sea, in addition to a growing demand and development of infrastructure, wind and hydro power, mining, and recreational resorts. Northern Norway historically contains grazing grounds for semi-domestic reindeer, and increased development leads to extensive avoidance of developed areas by reindeer, especially females and calves. Loss of grazing land is considered the largest threat to future reindeer husbandry.
Throughout the last century, temperatures have risen significantly in Sami reindeer husbandry areas. The season without snow or ice cover has subsequently become longer, and freeze-thaw cycles have appeared more frequently in winter. Most scenarios predict that temperatures will continue to rise both in summer and winter. In addition, more severe storms and winds are expected, as well as increased precipitation. For reindeer grazing conditions, this will lead to more unstable winters in continental areas, with a further increased frequency of freeze-thaw cycles and subsequent icing of pastures. Summer pastures may change from open to shrub-vegetated land, and temperatures will likely become more favorable for parasites and diseases.
The impacts of loss of land due to development and climate change will vary locally, likely leading to greater inequity and differences between siidas (groups of reindeer herders) and their resource bases. Internal conflicts among siidas may become more common, as poor grazing conditions in one area may lead to increased pressure on neighboring areas. A central challenge for research will be to quantify and model possible separate and synergistic effects of development pressures and climate change on seasonal pasture use, foraging efficiency and production. Which areas are likely to be impacted, and how? Will this affect seasonal pasture use and husbandry practices? How has reindeer husbandry responded historically to sudden changes in climate or loss of grazing grounds? It is important to identify critical areas and regions where herders may become exposed to multiple stressors and evaluate their potential need for moving herds into other areas, with subsequent increased competition for forage and grazing rights.
Projected changes may have wide consequences for siida-relationships, pasture zone organization and large management sectors. External conflicts between reindeer herders and other stakeholders are also likely to increase, stakeholders being i.e. local and regional authorities and developers. Changing resource conditions raises a series of questions about how well the current institutions and policies are suited to deal with foreseeable changes. For reindeer herder organizations, a central challenge will be to create a common understanding of land use rights and responsibilities for each siida and each grazing zone. If a common understanding can be reached, development projects can be fronted by the entire grazing region, not only the affected siida, as loss of land for one siida eventually will affect neighboring siidas. A unified understanding within a region can also enable the development of regional systems for handling extreme weather conditions, such as supplementary feeding or more flexible systems of pasture use. Most importantly, it is vital to create forums and meeting places where neighboring siidas can discuss solutions to challenges that affect the entire region.

Reindriftens tilpasningsstrategier i forhold til tap av beiteland og klimaforandringer

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I løpet av det siste tiåret har det vært økt økonomisk og politisk interesse for Nord-Norge på grunn av åpningen for petroleumsvirksomhet i Barentshavet, samt på grunn av en økende utbygging av infrastruktur, vind- og vannkraft, gruvedrift, mineralleting og hyttebygging. Størsteparten av landsdelen er tradisjonelt brukt som reinbeite, og økt utbygging fører til at reinen reduserer bruken av utstrakte områder nær inngrep. Dette gjelder spesielt simler og kalv. Tap av beiteland blir karakterisert som den største trusselen mot reindrift i framtiden.
Gjennom de siste hundre årene har temperaturen økt signifikant i samiske reindriftsområder. Barmarksesongen har blitt lengre, og perioder med vekslende mildvær og frost har blitt vanligere om vinteren. De fleste scenarier viser at temperaturene vil fortsette å stige både om sommeren og vinteren. I tillegg ventes det mer vind og flere stormer, samt økt nedbør. For reinens beiteforhold betyr dette at vintrene blir mer ustabile på innlandet, med en fortsatt økning av mildværsperioder og nedising av beitene. Sommerbeitene kan endre seg fra åpent til busk- og skogkledd landskap, og temperaturene vil trolig bli mer gunstige for parasitter og sykdom.
Konsekvensene av klimaforandringer og tap av beiteland på grunn av utbygging vil variere lokalt, og dette vil trolig føre til økte forskjeller mellom de enkelte siidaenes (reindriftsgruppenes) naturgrunnlag og beiteområder. Interne konflikter mellom siidaene kan bli mer vanlige siden dårlige beiteforhold i ett område kan føre til økt press på naboområder. En stor utfordring for forskningen vil være å kvantifisere og modellere mulige atskilte og synergistiske effekter av utbyggingspress og klimaendringer på beitebruk og produksjon. Hvilke områder blir berørt, og hvordan? Vil dette endre beitebruken gjennom året og driftsmønsteret? Hvordan har reindriften tidligere respondert på plutselige endringer i klima eller tap av beiter? Det er viktig å identifisere kritiske områder der reindriften kan bli utsatt for flere negative konsekvenser samtidig, og der det kan oppstå et behov for å flytte reinen til andre områder med påfølgende økt konkurranse om beiter og bruksrettigheter.
De skisserte endringene kan få store konsekvenser for forholdet mellom siidaer, innad i beitesoner, og i overordnet forvaltning. Eksterne konflikter mellom reineiere og andre interessegrupper vil sannsynligvis også øke, for eksempel i forhold til lokale og regionale myndigheter eller utbyggere. Det blir aktuelt å spørre om dagens regimer og politikk er forberedt på å takle de forventede endringene i ressurssituasjonen. For reineiernes styrer og organisasjoner blir det en stor utfordring å skape en felles forståelse av bruksrettigheter og plikter for hver siida og beitesone. Hvis man når en slik felles forståelse kan utbyggingssaker bli behandlet av hele beitesonen, ikke bare av den berørte siidaen, siden tap av beiteland for en siida vil ha konsekvenser også for nabosiidaene. En felles forståelse innen et område kan også danne grunnlag for felles strategier for å møte vanskelige klimaforhold, f.eks. gjennom tilleggsfôring eller mer fleksibel beitebruk. Det viktigste er å danne arenaer og møteplasser der nabosiidaer og beitesoner kan diskutere løsninger til de utfordringene som angår hele regionen.

Resonance strategies of Sami reindeer herding during climatically exceptional years in 1960-2007

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The resonance strategies of Sami reindeer herders during climatically exceptional years were studied in four reindeer herding cooperatives in northernmost Finland. The study was conducted by using interviews of reindeer herders, statistics of reindeer numbers and weather data. Serious losses of reindeer occurred in 1962-1963, 1965-1967 and 1972-1974. The study indicated that the resonance strategies are different in "fell herding cooperatives" from those in "forest herding cooperatives", and greatly depend on the practical knowledge of soil and pasture types, microclimate, topography and socio-ecological factors affecting reindeer herding. Before 1960s the reindeer herders were able to resonate with the changing conditions due to intensive herding techniques together with semi-tamed reindeer and the smokes and shelters for inhibiting insect harassment. In 1960s and 1970s the reindeer herders did not have sufficient means to prevent the serious reindeer losses, because pastures could not be used freely due to the border fences that were build around the reindeer herding cooperatives, and the use of snowmobile in herding had started. In 1990s the reindeer herders of the "fell herding cooperatives" Kaldoaivi and Paistunturi avoided consequences of bad weather conditions such as ice crust and mold by resonating with pasture rotation and leaving summertime calf markings out. In "forest herding cooperative" Hammastunturi reindeer herders coped with the long snowy springs of 1990s by using calving corrals, and in Ivalo, pasture rotation was taken back into use. In 2000s all four herding cooperatives have utilized supplementary feeding of reindeer as a strategy for coping with the most critical months of the late winter. This research showed that the resonance strategies in the studied herding cooperatives are both heterogenic and dynamic – they change constantly and include both old and new ways to cope with changing weather conditions.

Saamelaisen poronhoidon resonanssistrategioita poikkeuksellisissa sääolosuhteissa vuosina 1960-2007

Tutkimuksessa käsitellään Suomen saamelaisalueen paliskuntien: Kaldoaivin, Paistunturin, Hammastunturin ja Ivalon resonanssistrategioita poronhoidollisesti poikkeuksellisina vuosina. Tutkimusmetodeina käytettiin poronhoitajien haastatteluja, Paliskuntain yhdistyksen porotilastoja ja Ilmatieteenlaitoksen säädataa. Tutkimuspaliskunnissa oli katovuosia vuosina 1962-1963, 1965-1967 ja 1972-1974. Tutkimuksen mukaan vaikuttaa siltä, että tunturipaliskunnilla ja metsäpaliskunnilla on erityyppisiä resonanssistrategioita, jotka ovat suoraan verrannollisia poronhoitajien inhimilliseen tietoon mm. maa- ja laiduntyypeistä, mikroilmastosta, topografiasta ja sosio-ekologisista tekijöistä. Aina 1950-luvulle asti poronhoitajat kykenivät resonoimaan muuttuvissa olosuhteissa intensiivisen laiduntamisen ansioista, heillä oli käytössä muun muassa räkkäsuojat ja –savut. 1960-1970 –lukujen aikana poronhoitajat olivat murroksessa, sillä porot saivat laiduntaa jo suhteellisen vapaasti rajatuilla alueilla. Moottorikelkan käyttöönotto lisäsi poron "villiintymistä" eli vapaata laidunnusta. 1990-luvulta lähtien Paistunturissa ja Kaldoaivissa jätettiin kesämerkitys kokonaan pois ja poroja alettiin ohjaamaan heinillä sopiville talvilaitumille, minkä ansiosta vältettiin ne vaikeudet, jotka olisivat tulleet paanteisesta maakerroksesta. Hammastunturin paliskunnassa siiryttiin aitavasotukseen, joka takasi poroille vakaat olosuhteet pitkinä lumisina keväinä. Ivalon paliskunnassa siirryttiin vakaisiin ruokintajuontoihin kevätkuukausina. 2000-luvulla kaikissa neljässä paliskunnassa on käytettyn laidunnukseen liittyvää ruokintaa kevään vaikeina kuukausina. Tutkimus osoittaa sen, että resonanssistrategiat ovat hyvinkin hetoregeenisia ja dynaamisia – ne muuttuvat jatkuvasti ja niissä käytetään hyväksi sekä vanhaa että uutta tietoa suhteessa säihin ja ilmoihin.

Seasonal variation in meat quality attributes from Alaska reindeer (*Rangifer tarandus tarandus*) and New Zealand red deer (*Cervus elaphus*)

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Deer are typically found in geographical areas with marked seasons, and different species have to varying degree adapted to this seasonality. Deer species managed by humans originate from areas ranging from temperate to boreal (red and fallow deer) to subarctic to arctic (reindeer), representing environments with moderate and extreme seasonal changes, respectively. Thus, deer have a seasonal growth pattern with maximum accretion of body tissue (muscle and fat) in spring and summer; weight may be lost particularly by males, during autumn with little or no weight gain taking place over the winter. Previous studies have investigated the underlying physiological mechanisms responsible for the seasonal control of growth, but have not related that to possible effects on meat quality attributes.
In this paper meat quality data from two recent seasonal studies are presented; 1) reindeer (*Rangifer tarandus tarandus*) bulls and steers slaughtered at three different times during the year (July, November and March) on the Alaska Seward Peninsula and 2) red deer (*Cervus elaphus*) stags slaughtered at four different times (July, September, December and March) in New Zealand.
In the Alaskan study, 42 reindeer were included in the study (19 bulls and 23 steers). All animals came from the same herd out on the Seward Peninsula, Alaska. Carcasses were gutted and dressed out in the field, and then transported within 24 hours post slaughter to a meat processing facility for further sampling and boning. Seasonal effects in reindeer carcass composition were demonstrated in this study, although the carcasses from the late slaughter (March) had higher weights and a greater proportion of valuable cuts than expected. Proximate composition of the meat was similar between the three groups and two sexes. Seasonal effects were demonstrated in the consumer important attributes meat tenderness and juiciness with the November samples scoring highest for both attributes. Results of this study support the concept of slaughtering reindeer over a greater period of time, which could increase fresh product availability for retail and food service markets.
In New Zealand, 68 red deer stags were included in the study. Animals were slaughtered at a specialized deer slaughter export facility according to standard practices. Meat from deer slaughtered in December was most tender and had the highest drip loss. These results were consistent for samples stored at -1.5 °C for up to 9 weeks post slaughter. Measurements of the tenderising enzymes (calpains) indicated that while the enzyme levels and ratios do vary over the 12 month period there is no clear suggestion that this enzyme system alone is responsible for the variation in tenderness. In conclusion, seasonal effects were found in drip loss and tenderness measurements and overall there was a positive correlation of increased tenderness and increased drip loss. A challenge is to improve the processing of deer carcasses to minimize drip without negatively impact on tenderness.

Säsongsvariation i köttkvalitet hos ren från Alaska och kronhjort från Nya Zeeland

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Hjortar finns huvudsakligen i geografiska områden med markerade årstider och olika arter har i varierande grad anpassats till denna säsongsvariation. Hjortarter som domesticerats/farmas lever i områden som sträcker sig från tempererade och boreala (kron- och dovhjort) till subarktiska och arktiska (renar), som är exempel på miljöer med måttliga till extrema säsongsmässiga variationer i klimat. Följdaktligen har hjortar ett säsongsbetonat tillväxtmönster med hög tillväxt (muskler och fett) under våren och sommaren, viktminskning under hösten i synnerhet hos handjur, och en väldigt liten eller ingen viktökning alls under vintern. Tidigare har de underliggande fysiologiska mekanismer som ansvarar för den säsongsbetonade kontrollen av tillväxt undersökts, men inga studier har fokuserat på eventuella effekter på köttets kvalitet.
I denna undersökning presenteras köttkvalitetsdata från två säsongsrelaterade studier: 1) ren (*Rangifer tarandus tarandus*) sarvar och härkar som slaktats vid tre olika tidpunkter (juli, november och mars) på Seward Peninsula i Alaska och 2) kronhjort (*Cervus elaphus*) handjur som slaktats vid fyra olika tidpunkter under året (juli, september, december och mars) i Nya Zeeland.
I Alaska ingick 42 renar i studien (19 sarvar och 23 härkar). Alla djur kom från samma renägare och renhjord på Seward Peninsula. Slakten skedde i fält och sedan transporterades slaktkropparna (inom 24 timmar) till en styckningsanläggning för styckning och provtagning. Säsongsmässiga effekter i slaktkroppssammansättning demonstrerades, även om slaktkropparna från slakten i mars hade högre vikter och en större andel av värdefulla styckningsdetaljer än väntat. Den kemiska sammansättningen hos köttprover från de tre grupperna var jämförbar både mellan grupperna och de två könen. Säsongsmässiga effekter påvisades i mörhet och saftighet vid en konsumenttest där novemberproverna hade de högsta värdena för båda attributen. Resultaten av denna studie stöder idén att slakta renar över en längre tidsperiod, vilket skulle kunna öka tillgängligheten av färska renprodukter för restaurang- och detaljhandeln.
I Nya Zeeland ingick 68 kronhjortar (handjur) i studien. Djuren slaktades enligt normal rutin i specialdesignade hjortslakterier godkända för export. Kött från hjortar slaktade i december var mörast och hade den sämsta vattenhållande förmågan. Dessa resultat gällde för prover som förvaras vid -1.5 °C i upp till 9 veckor efter slakt. Mätningar av mörhetsenzymer (calpainer) visade att enzymnivåer och förhålladet mellan enzym/inibitor varierar under året, men det gick inte att dra slutsatsen att denna variation i enzymaktivitet är huvudansvarig för variationen i mörhet. Sammanfattningsvis drogs slutsatsen att det finns en säsongsmässig variation i mörhet och vattenhållande förmåga i hjortkött och att mörare kött förlorar mer vätska. En utmaning för slaktindustrin är att förbättra slaktkroppshanteringen för hjortar för att minimera vätskeförlust utan negativ inverkan på mörhet.

Female body mass variation as indicator of nutritional status in the reindeer herd

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In an ongoing project we follow the body mass of about 600 adult female reindeer in two herds. Live body mass has been registered in early winter (late October to December) 2007 and 2008 and, in one of the herds, also in the spring (April) 2007 and 2008. Calves of the females have been individually marked and weighed in July and in early winter. The plan is to continue the study for at least two more years. One aim is to find out whether variations in body mass of individual animals can be used as indicator of variations in body condition and nutritional status of the whole herd, and thus as indicator of variations in the quality of pastures. A benefit of following live reindeer, compared to e.g. using slaughter data, is that the animals could be randomly selected within the herd. The results will be independent of possible changes in slaughter strategy and selection of animals for slaughter. By following known individuals, each animal could serve as its own control.
There were clear differences between years according to the preliminary results on female body mass. The results were in agreement with the herders' own perception of the quality of pastures. In early winter, the body mass of females, that had been observed not having a calf during summer, was considerably higher than for females having a calf. Information on reproductive status is thus crucial. Female age seems not to affect body mass significantly at ages between three and eight years. Weighing of live reindeer involves a great deal of labour. It has to be made when the reindeer are gathered for other purposes and special arrangements may have to be made at the gathering site. It is also important that the weighing does not cause extra stress to the reindeer, which might be detrimental for animals in poor condition.

Viktvariation hos vajor som indikator för nutritionell status i renhjorden

I ett pågående projekt följer vi levande vikter hos omkring 600 vuxna vajor i två renhjordar. Levande vikt har registrerats på förvintern (slutet av oktober fram till december) 2007 och 2008 samt, i den ena hjorden, även på våren (April) 2007 och 2008. Vajornas kalvar har märkts med nummerbrickor och vägts i juli och på förvintern. Planen är att fortsätta studien i ytterligare minst två år. Ett syfte är att ta reda på om variationer i levande vikt hos kända individer kan användas som indikator för variation i kondition och nutritionell status för hela renhjorden och därmed som indikator för variation i betets kvalitet. En fördel med att följa levande renar, jämfört med att exempelvis använda slaktdata, är att djuren kan väljas slumpmässigt. Resultaten påverkas därmed inte av slaktstrategi och slakturval. Genom att följa enskilda individer kan varje djur fungera som sin egen kontroll.
Preliminära resultat på vajornas vikter visar klara skillnader mellan år, vilket är i överensstämmelse med renskötarnas egen uppfattning om betets kvalitet. Kroppsvikten på förvintern var betydligt högre för de vajor som observerats utan kalv på sommaren än för dem som hade kalv. Det är således väsentligt att ha kunskap om vajornas reproduktiva status. Vajornas ålder hade ingen signifikant inverkan på vikt för de vajor som var tre till åtta år gamla. Vägning av levande renar innebär mycket arbete. Det måste göras när renarna samlas och skiljs för andra ändamål och speciella arrangemang kan krävas vid skiljningsanläggningarna. Det är också viktigt att vägningen inte orsakar extra stress för renarna, vilket skulle kunna vara skadligt för djur i dålig kondition.

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

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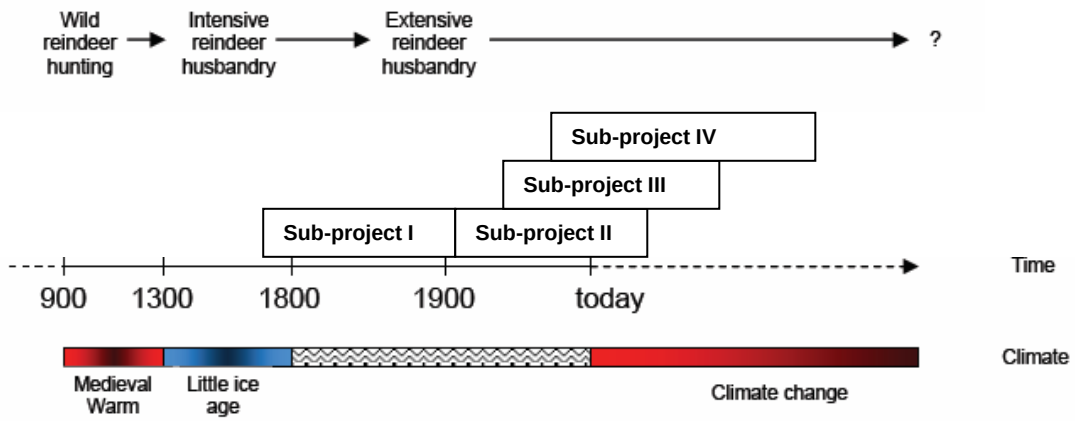
Knowledge about previous adaptations made by the Sami community to climatic and societal changes provides insight on the historical processes underlying reindeer herding practices today, and potential restrictions or opportunities of future adaptation options.
The multidisciplinary research group we 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.

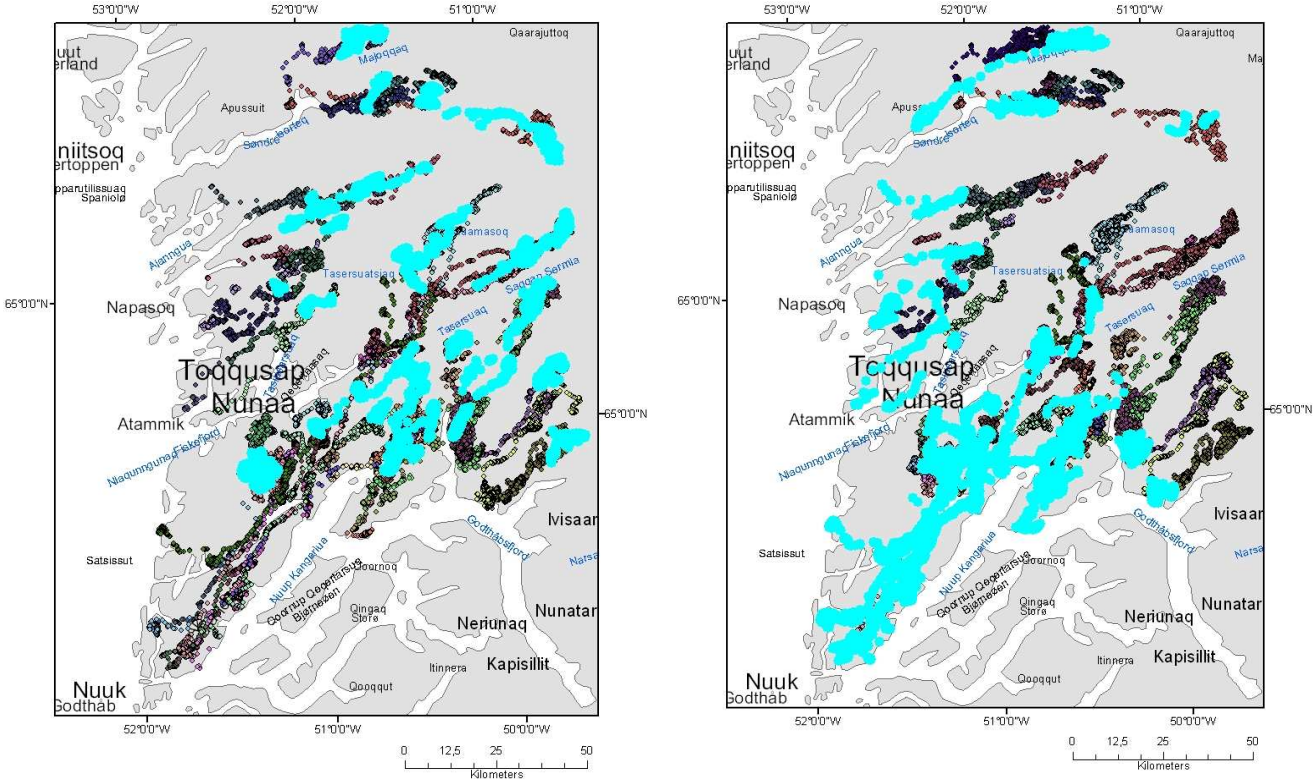

Fig. 1. Summary of caribou positions (highlighted with cyan) during calving May 25 to June 25 to the left. To the right caribou positions (highlighted with cyan) in autumn/early winter October 2008. The figure also shows all other locations to illustrate all movements during the study period.

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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).

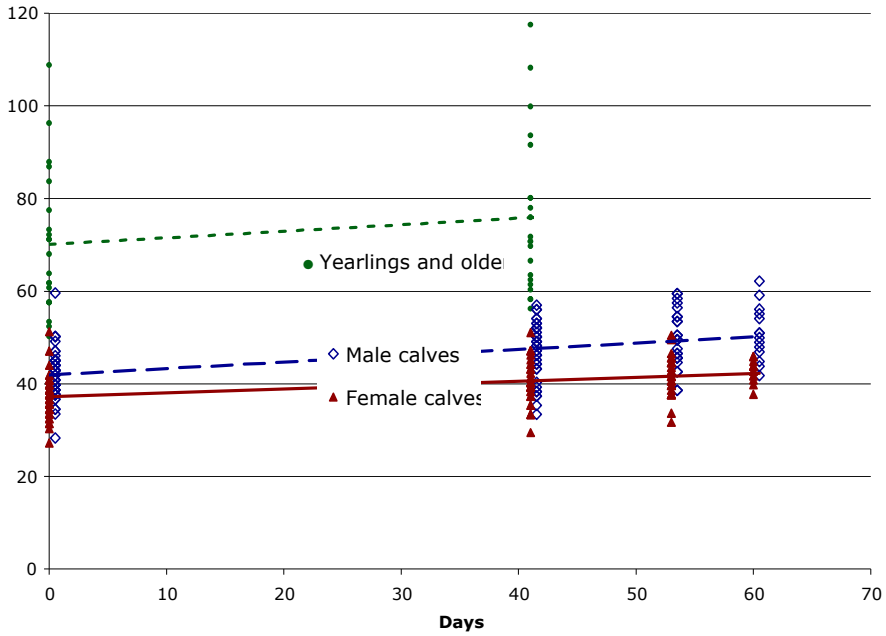

Fig. 1. Live body mass change for the different categories of reindeer during the experiment (body mass is recalculated according to the average relative carcass weight at each weighing occasion, respectively, to compensate for possible systematic differences in the amount of stomach content).

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).

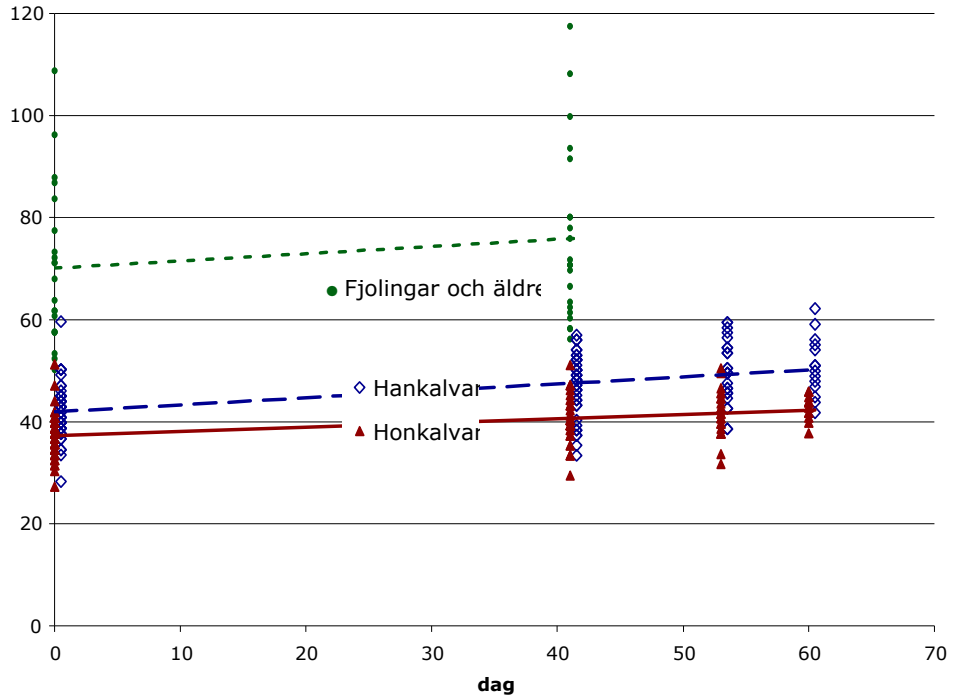

Fig. 1. Förändring av levande vikt under försöket i olika kategorier av renar (vikten är korrigerad med hänsyn till slaktutbyte vid de olika tidpunkterna för att kompensera för eventuella olikheter i magfyllnad).

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.

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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.

Julkaisu

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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:

Laaksonen, S., Kuusela, J., Nikander, S., Nylund, M., & Oksanen, A. 2007. Parasitic peritonitis outbreak in reindeer (*Rangifer tarandus tarandus*) in Finland. – *The Veterinary Record* 160: 835-841.

Nikander, S., Laaksonen, S., Saari, S., & Oksanen, A. 2007. The morfology of the filaroid nematode *Setaria tundra*, the cause of peritonitis in reindeer *Rangifer tarandus*. – *Journal of Helminthology* 81: 49-55.

Laaksonen, S., Solismaa, M., Orro, T., Kuusela, J., Saari, S., Nikander, S., Oksanen, A., & Sukura, A. 2008. *Setaria tundra* microfilariae in Finnish semi-domesticated reindeer (*Rangifer tarandus tarandus*) and wild cervids**.** –*Parasitology Research* 10.1007/s00436-008-1184-0.

Laaksonen, S., Oksanen, A., Orro, T., Norberg, H., Nieminen, M., & Sukura, A. 2008. Efficacy of different treatment regimes against setariosis (*Setaria tundra*, Nematoda: Filarioidea) and associated peritonitis in reindeer. – *Acta Veterinaria Scandinavica* 2008, 50, 49 doi:10.1186/1751-0147-50-49.

Laaksonen, S., Solismaa, M., Kortet, R., Kuusela, J., & Oksanen, A. 2009. Vectors and transmission dynamics for *Setaria tundra* (Filarioidea; Onchocercidae), a parasite of reindeer in Finland. – *Parasites & Vectors* 2:3.

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.

References down on next page.

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.

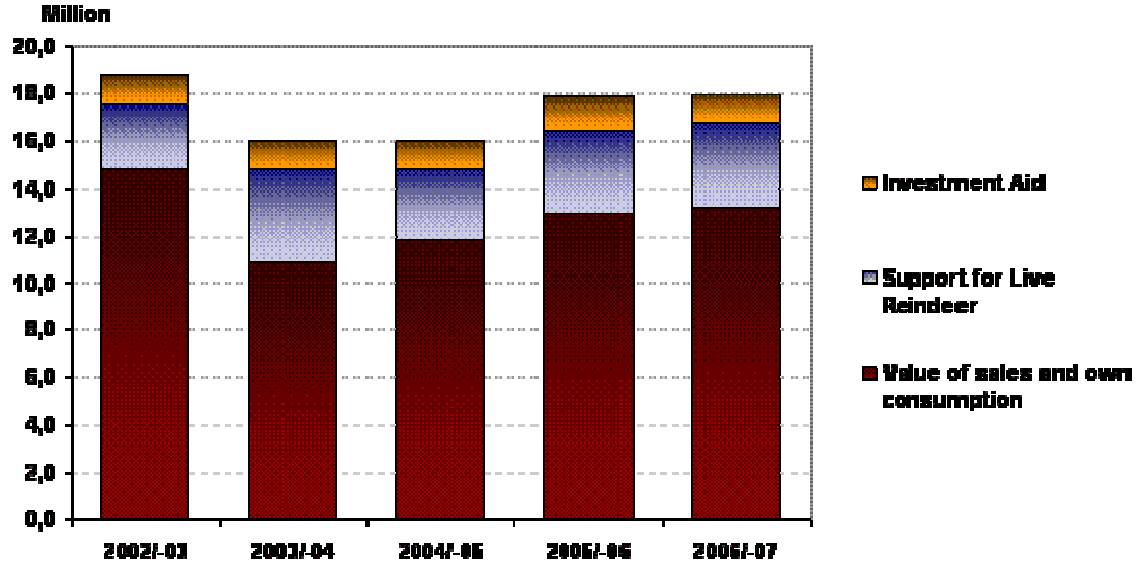

Fig. 1. Total revenue of reindeer husbandry in 2002- 2007.

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.

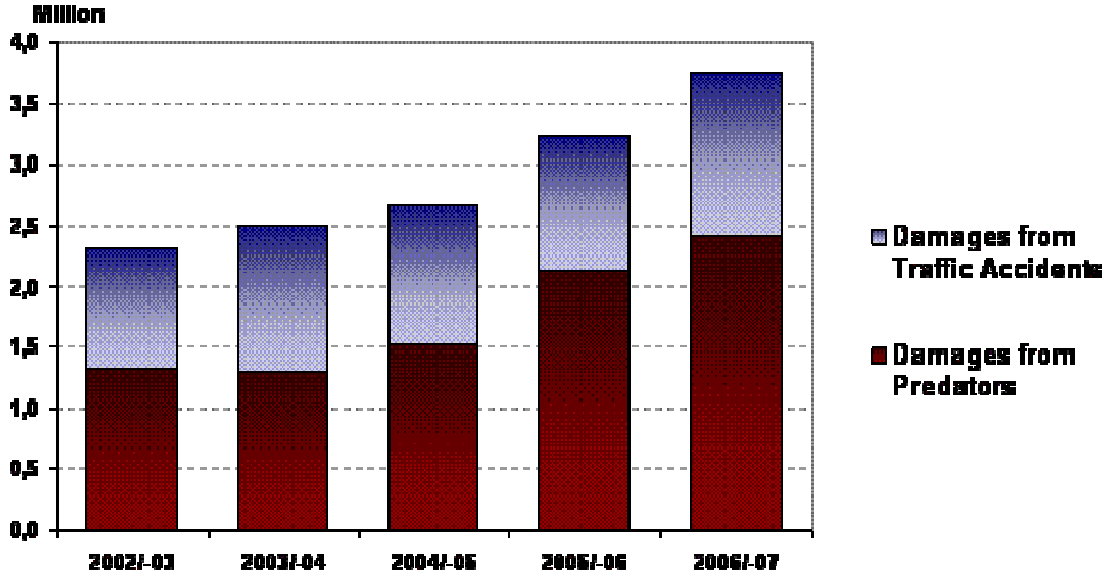

Fig. 2. The amount of compensations to the reindeer husbandry in 2002- 2007.

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.

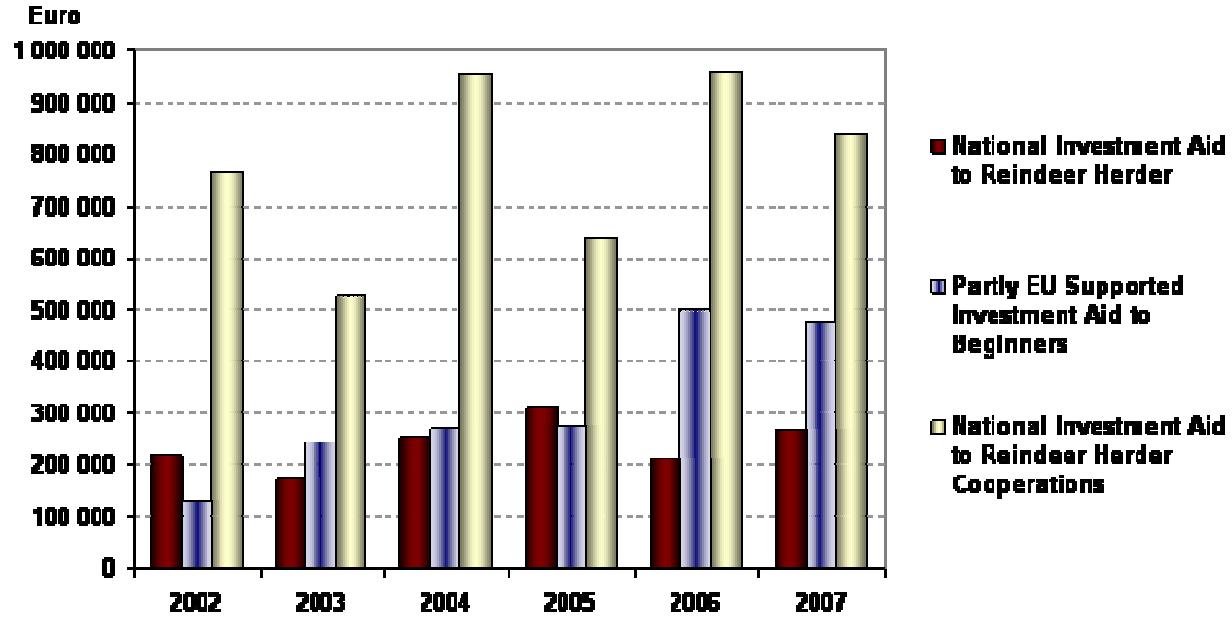

Fig. 3. The amount of investment aids to the reindeer husbandry in 2002- 2007.

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

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The Swedish University of Agricultural Sciences (SLU)
announces a position as

PROFESSOR IN REINDEER HUSBANDRY

Department of Animal Nutrition and Management
Faculty of Veterinary Medicine and Animal Science

The Faculty of Veterinary Medicine and Animal Science at SLU conducts research and education to promote the health and well-being of animals as well as humans and to develop a biologically and economically sustainable animal management. The faculty's research area comprises basic biomedical sciences, animal management, -health, and -welfare, veterinary medicine, veterinary public health and the influence of animals for the health and well-being of humans. We are now seeking a dynamic and creative leader and outstanding investigator to play a central role in the development of our Faculty. The successful candidate with established network will be expected to build an extramurally funded research program and to have a genuine interest in teaching issues.

Subject description: The subject area is multi-disciplinary and includes biological as well as social aspects of the reindeer industry, emanating from an animal science and industry perspective.

Duties: Overall responsibility for research and teaching within the subject. Main duties include research, education at doctorate level and teaching within the faculty's comprehensive teaching task at bachelor and master levels. The position includes communication of scientific knowledge within the subject area to the reindeer industry and other stakeholders. Furthermore, the remit includes administrative tasks and assignments within the department and the faculty.

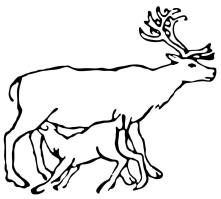
Complete notice of the position can be found on
http://dokument.slu.se/ansti/taf/ledans_rd.taf?function=sluwebbakt

Welcome to the XXIX IUGB Congress 2009

We are pleased to inform that the XXIX Congress of the International Union of Game Biologists will take place on August, 17-22, 2009 in Moscow, Russia.
The dominant theme of the Congress is
"Wildlife management as one of the most significant ways of wildlife preservation".
The special topic is **"International cooperation of saiga conservation"**.
Within the frames of the Congress four plenary sessions, symposiums and special sessions will be held as well as 18 sections will discuss specific subjects.

For further information and registration, please visit the congress' website

www.iugb-moscow2009.ru



Rangifer

To the participants at NOR's conference
To the authors of lectures and poster presentations

Since last year, NOR's journal Rangifer has become an open access, online journal. The main argument for this new orientation concerns the modern possibilities for mediating scientific knowledge in a free and open way. However, this change does not alter the journal's demand for high quality publishing. The normal issue periodical Rangifer in English is from 2008 published as one issue per year with consecutive publishing of accepted material. In addition, there will still be occasional Rangifer special issues and Rangifer reports; this conference report is an example of the latter.

The conference organizers will urge you to use the possibilities for publishing in Rangifer normal issue. We will especially ask the authors presenting at our conference to consider this possibility for the works you have presented. If so, the lectures and poster presentations have to be revised to correspond with demands for scientific writing. Information for contributors to Rangifer is found at the web address www.ub.uit.no/baser/rangifer/ .

A full article in Rangifer normal issue will
- give a peer reviewed article for the benefit of author and readers.
- give a presentation which is accessible for everybody.
- reach far beyond the conference itself and be available internationally.
- contribute as to get more articles published in Rangifer.
- strengthen Rangifer as an important journal for reindeer and reindeer related research.

You will find more about Rangifer at the above web address. There you also will find free access to Rangifer online. Besides, back issue articles are available via link in NOR's web pages www.rangifer.no

We hope you will consider publishing in Rangifer and submit manuscripts to get an even better journal.

Thank you!

On behalf of the organizers and NOR

Rolf Egil Haugerud
Secretary General of NOR / Editor of Rangifer

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