Postersesjoner – Postere / Postersessions – Posters

Posternr – Poster Numbers side/page

Sesjon 1 – Session 1 (oddetall – uneven number)

1. Peter Aastrup et al. Caribou collaring project in West Greenland – an update 83

3. Morten Heide & **Tove Aagnes Utsi** 88
Reindeer calf meat, a unique product? Reinkalv kjøtt, et unikt produkt?

5. Arvid Holte & Jan Åge Riseth
Reindeer husbandry and protected areas. Reindrift og områdevern 90

7. Berit Inga 93
The reindeer as barometer – to use traditional ecological knowledge among reindeer herding Sami of reindeer behavior as an indicator on climate changes
Renen som en barometer – att använda traditionell ekologisk kunskap hos renskötande samer om renens beteenden som en indikator på klimatförändringar

9. Stein Rune Karlsen, **Bernt Johansen** et al.
Potential effects of temperature increase on forest distribution on Finnmarksvidda, northern Norway 96
Potensiell fremtidig skogsutbredelse på Finnmarksvidda som følge av temperaturøkning 98

11. Eirik Malnes et al. 102
Satellite remote sensing of snow on reindeer pastures in the Torneträsk region
Satellittovervåkning av snø på reinbeiter i torneträskområdet

13. Anna Olofsson et al.
Indicators for monitoring changes in grazing resources 105
Indikatorer för mätning av förändringar i betesresurserna 106

15. Jan Åge Riseth et al. 107
Sami TEK as a guide to climate change science: Impacts of snow, ice and reindeer pasture
Samisk tradisjonskunnskap som veiviser for forskning på klimaendringer: Virkninger for snø, is og reinbeiter

17. Minna Turunen et al.
Vegetation Changes in Reindeer Winter Corrals in Finnish Lapland 110
Porojen ruokinta-aitausten kasvillisuusmuutokset Suomen Lapissa 111

19. Eva Wiklund, Ol-Johan Sikku, & Anders Blom
Renlycka – a Sami quality trademark for reindeer meat 113
Renlycka – ett samiskt kvalitetssigill för renkött 114

Sesjon 2 – Session 2 (partall – even number)

2. Yann Buhot, **Anna Skarin**, & Per Sandström
Impact of hydroelectric power development on reindeer husbandry: the case of Suorva 86
Påverkan av vattenkraftutbyggnad på renskötseln i Lule älvdal 87

4. Øystein Holand et al. 89
Who cares at what cost? Induced orphaning reveals post-weaning maternal care in reindeer
Simleløse kalver taper meir vekt gjennom vinteren enn kalver som har mora til stede i flokken.

6. Arvid Holte
Methods for assessing large and irreversible constructions, military -, public - and commercial activities in reindeer pasture areas 91
Metoder for å vurdere store og irreversible arealinngrep og aktiviteter i reindriftsnæringens beite- og driftsområder 92

8. Cecilia Johansson[1]
Is the snow structure changing? Results from snow structure observations in Abisko Scientific Research station, Sweden 94
Håller snön sammansättning på att ändras? Resultat från snöprofilobservationer utförad vid Abisko naturvetenskaliga forskningsstation, Sverige 95

10. Jouko Kumpula & Mika Kurkilahti
Which factors explain the amounts of ground lichens on reindeer pastures? 100
Mitkä tekijät selittävät maajäkälien määriä porolaitumilla? 101

12. Kirsi Muuttoranta, Mauri Nieminen, & **Asko Mäki-Tanila**
Estimation of maternal effects on weight records of Kutuharju reindeer 103
Emien vaikutuksen arviointi Kutuharjun porojen painoista 104

14. Asgrim Opdal (short oral information)
The concession reindeer companies of southern Norway. Tamreinlaga i Sør-Norge.

16. Monica A. Sundset, **Kia K. Hansen** et al.
Rumen metanogens and methane emission from reindeer 108
Metanogener i reinens vom og utslipp av metan fra rein 109

18. Pauliina P. Wäli et al. 112
Reindeer avoid eating ergot fungus. Porot välttävät torajyvän syömistä.

20. Eva Wiklund, Anneli Jonsson, & Lennart Blindh
Microbiological shelf life of fresh, chilled reindeer meat (*M. longissimus*) 115
Mikrobiologisk kvalitet hos färskt kyllagrat renkött (*M. longissimus*) 116

[1] Best poster in show.

Caribou collaring project in West Greenland - an update

Peter Aastrup[1], Lars O. Mortensen[1], Caroline Ernberg Simonsen[1], Mary Wisz[1], & Christine Cuyler[2]

[1]National Environmental Research Institute, Aarhus University (pja@dmu.dk). [2]Greenland Institute of Natural Resources, Nuuk, Greenland.

The construction of hydro-power plants and transmission lines, roads and other infrastructure affect a large area between Nuuk and "Sukker-toppen Iskappe". This area also accommodates the important caribou herd south of "Sukkertoppen Iskappe", the Akia-Maniitsoq herd.

The objectives of this study are to provide: 1) A solid basis for studying and documenting present caribou range use. 2) 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.

We collared 40 females, most of them pregnant, in May 2008. The procedure is described by Cuyler, 2008. Collars were deployed on female caribou over the entire region in order to provide data that should be representative for the whole study area. Positions have been received since May 2008 and we are still receiving positions with 2-4 hour intervals.

Data covering the time period from May 2008 until the end of October 2009 showed track length varies between individuals from one to five km per day. The longest track recorded was more than 2700 km for the whole study period while the shortest track recorded for the whole study period was 517 km. A total of 85 migratory tracks were recorded during the study period. Three individuals did not migrate and for eight individuals we could not establish whether migration took place or not due to transmitter problems. Migrations occurred during the entire year but in October and May many individuals migrated at the same time indicating synchronized movements. Movements are at a low in winter and highest in summer. The overall pattern is that caribou occur inland from June-July until September-October while they spend the winter closer to the coast. In the migration period caribou are on their way between the inland and the coastal ranges. During calving caribou occur throughout the range except the coastal regions.

Generally our data indicate that caribou occur all over the study area. However, there is a pronounced difference: the caribou mainly stay in coastal ranges in winter and mainly in the inland in summer. The snow conditions and high altitudes in the inland do not provide optimal foraging conditions for the caribou and vegetation is sparse in these areas.

Important vegetation types for foraging are occurring widely in the area except parts of the northern and central regions of the study area. Only few individual core areas are located here, and none in winter. It appears that the northernmost part of the study range is less important for caribou than the southern. Caribou collared to the north have had a high proportion of failure due to dead animals. Therefore this conclusion should be taken with caution.

The areas where the caribou stay most have a higher proportion of vegetated surface than the entire area, but there are only minor differences in the composition of vegetation types preferred by the caribou between seasons. These results agree well with earlier studies (Aastrup 2004; Tamstorf et al 2005).

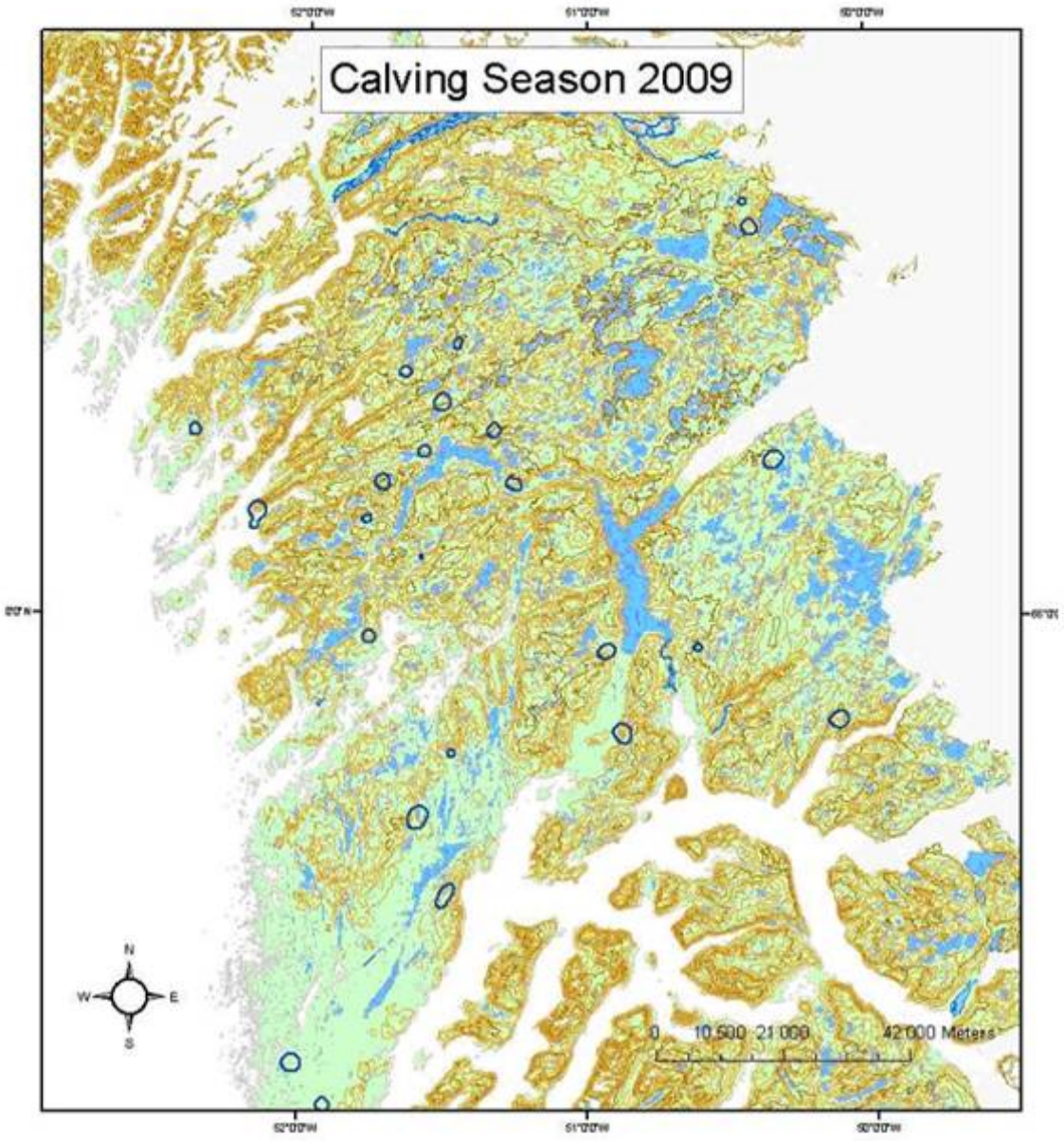

Fig.1. Individual core areas of collared caribou during the calving season 2008. *Please note that the title is wrong – the correct year is 2008.*

Calving (Fig. 1) is not aggregated, but rather widespread, and no specific area can be assigned as calving grounds, however the highest numbers of cows with calves were found in areas closer to the Greenland Ice cap (Nymand & Cuyler, 2009 and this study). Although calving is not aggregated, specific areas with optimal forage conditions are very important during calving. Such areas occur widely in the area.

We have identified the major migration routes. Most of these are located in Akia in the southwestern corner of the study area. These areas are of special importance during the migration periods. There is no clear synchrony in migrations. Fig. 2 shows average displacement distances:

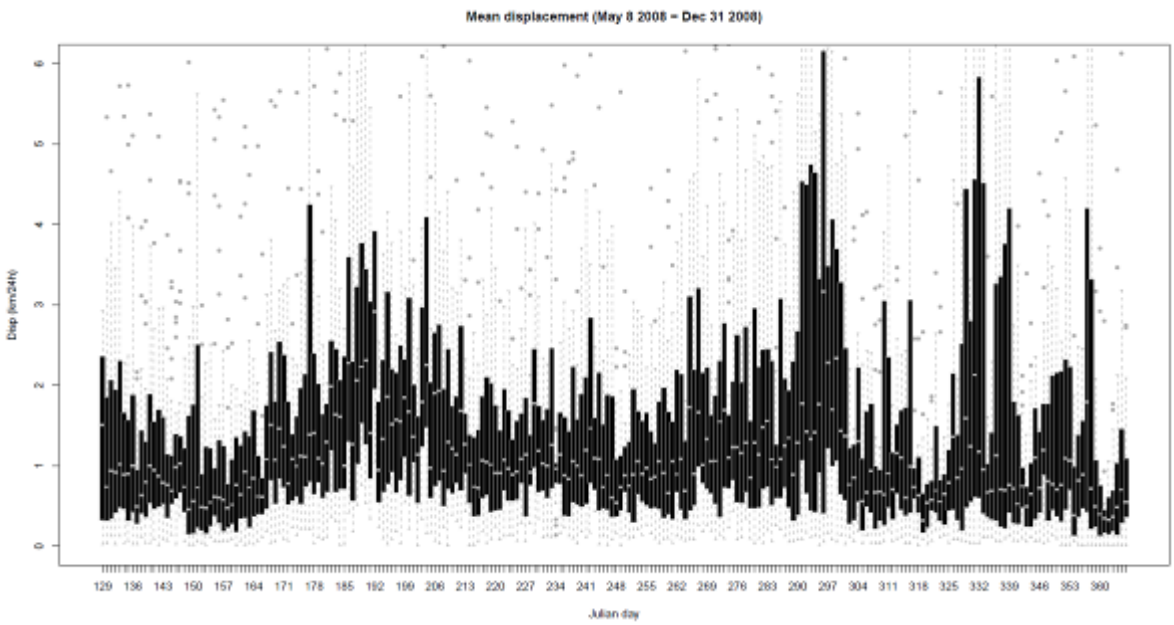

Fig. 2. Average displacement distances May 2008 to December 2008.

The study has provided unique data for analysing in more detail how caribou use the area. We can make analyses at a higher resolution in space and time. Further, many new methods for spatial modelling have been developed during the recent years.

We are attempting to use data for modelling the distribution of caribou. Analyses of positions from individual caribou so far indicate reduced spatial dependency up to 10 hours, and almost no spatial dependency after 20 hours. Modelling will be carried out on positions separated by both these time steps.

Such detailed spatial modelling should be done at a later stage on the full data-set, when all transmitters have stopped sending positions. Such analyses can be important for assessing the effects of disturbances and infrastructure. We have now data to document the “normal” pattern of movements at local scale within short time periods.

The dataset form a valuable documentation of caribou range use in the baseline situation. This dataset can be used in the future as a basis for monitoring effects of disturbances and infrastructure in relation to de-velopment of the area related to Alcoa or other activities.

Impact of hydroelectric power development on reindeer husbandry: the case of Suorva

Yann Buhot[1], Anna Skarin[1], & Per Sandström[2]
[1]Department of Animal Nutrition and Management, Swedish University of Agricultural Sciences, Box 7024, 75007 Uppsala (anna.skarin@huv.slu.se).
[2]Department of Forest Resource Management, Swedish University of Agricultural Sciences, 901 83 Umeå (Per.Sandstrom@srh.slu.se).

Reindeer husbandry in Sapmi continuously coexists and competes with other land users, such as forestry, tourism, hydroelectric power and mine activities. The impact of water regulation for hydroelectric power, on reindeer herding use is rather unknown. In Sirges reindeer herding community in northern Sweden a large part of their range are affected by hydroelectric power developments, which have forced the reindeer herding to change the use of their ranges. Here we study these changes in relation to the Suorva dam within Lule river system, one of 15 dams within Sirges reindeer husbandry community.

We compiled topographic maps from 1890 and 2007 and included the Renbruksplan (reindeer husbandry plan) developed by Sirges reindeer husbandry community. The Renbruksplan consists of the reindeer herder's documentation of seasonal grazing ranges within their reindeer husbandry community, in relation to vegetation type, intensity of use and quality of forage. Using topographic maps the losses of pasture in relation to the regulation of the Suorva dam were calculated using GIS software. The impacts on Unna Tjerusj reindeer herding community north of the dam Suorva are not included in this study.

The results of the study showed that after the four water regulations (1923, 1941, 1944 and 1972) the reindeer lost calving areas and autumn pastures composed of birch forest and mires. In Sirges 55 km² has been lost as a direct result of the flooding of grazing areas. This constitutes 6% of the ranges used during the bare-ground season in the Vaisa-group of Sirges herding ranges. This also includes the loss of important movement areas, which formerly connected seasonal grazing areas along the flooded rivers system and currently force the reindeer to use steeper less productive hillsides above the dam.
In conclusion, this study gives a good overview of how water regulation may affect reindeer herding. Due to the losses, the reindeer herders in this area had to change their migration routes and herding routines in relation to use of the calving grounds and the autumn pastures. These losses most likely had negative effects on reindeer husbandry production, because of the lack of good and rich forage during important parts of the grazing season, however this loss cannot be traced today.

Påverkan av vattenkraftutbyggnad på renskötseln i Lule älvdal

Yann Buhot[1], Anna Skarin[1] & Per Sandström[2]
[1]Insitutionen för husdjurens utfodring och vård, Sveriges Lantbruksuniversitet, Box 7024, 75007 Uppsala, (anna.skarin@huv.slu.se);
[2]Insitutionen för skoglig resurshushållning, Sveriges Lantbruksuniversitet, 901 83 Umeå, (Per.Sandstrom@srh.slu.se).

Rennäringen i Sapmi konkurrerar ständigt med andra areella näringar, som skogsbruk, turism, gruvindustri och vattenkraft. Det är relativt okänt hur vattenkraftutbyggnad har påverkat renskötseln. Lule älven är en av de mest utbyggda älvarna i Sverige med 15 olika dam och kraftverksutbyggnader och här har man också byggt Suorvadammen den största vattenreservoaren i Sverige idag. I den här studien har vi undersökt hur utbyggnaden av Suorvadammen har påverkat renskötseln i Sirges sameby.

Vi använde oss av topografiska kartor från 1890 och 2007 för räkna ut hur stora landarealer som översvämmades vid höjningen av vattennivån när Suorvadammen var färdigställd. Vi har även använt oss av renbruksplanen från Sirges sameby. En renbruksplan är ett GIS-verktyg som är utvecklat av samebyn och består av renskötarnas dokumentation av hur de använder renbetesmarkerna i förhållande till säsong, flyttleder, vegetation och beteskvalitet. Påverkan på Unna Tjerusj sameby norr om Suorvadammen är inte inkluderat i denna studie.

Efter fyra olika höjningar av vattennivån (1923, 1941, 1944 och 1971) visade det sig att renskötseln förlorat kalvnings- och höstbetesområden, som till största delen bestod av fjällbjörkskog och myrar. Ett direkt resultat av utbyggnaden var att Sirges sameby förlorade 55 km^2 landareal i området, vilket är 6% av Vaisagruppens (en av fyra betesgrupper i Sirges) året-runt marker. Dammbygget innebar också en förlust av viktiga flyttleder som tidigare sammanband de olika säsongsbetena längs med älvdalen, samt att man efter utbyggnaden inte längre kunde nå brantare områden i direkt anslutning till dammen som tidigare kunde nås underifrån.

Den här studien ger en god överblick av hur vattenkraftutbyggnader kan påverka rennäringen både direkt och indirekt. Renskötseln i det här området fick genomgå stora förändringar där de var tvungna att hitta nya flyttleder och nya kalvnings- och höstbetesområden i områden som inte är optimala för dessa ändamål. Dessa förändringar har förmodligen haft en negativ inverkan på produktiviteten i renhjorden, eftersom man förlorat betesområden med höga näringsvärden som användes under kritiska perioder av året, men dessa förluster kan vi tyvärr inte spåra idag.

Reindeer calf meat, a unique product?

Morten Heide[1] & Tove Aagnes Utsi[2]
[1]Nofima, Marked, N-9291 Tromsø, Norway (morten.heide@nofima.no). [2]Finnmark University College N-9509 Alta, Norway (toveu@hifm.no).

In the Norwegian market for game meat, there is little tradition for product differentiation. An example of this is reindeer meat. Even though more than half of the products sold in the market are calf meat, no distinction is made between meat from calves and adult reindeer. This is contrary to other forms of meat production, such as lamb and mutton, and veal and beef. The aim of this study was to determine if there are unique quality attributes that may help to differentiate meat from calves and adult reindeer. To investigate how the quality of these two products were perceived, chefs of 30 restaurants in Oslo, Stavanger, Troms and Alta were recruited to blind test beef sirloin of both products. The results show that the reindeer veal is perceived to have a lighter colour, milder game flavour and a tenderer texture than meat from adult reindeer. More than 50% of the chefs responded that they would buy reindeer veal if it became available. At the same time only seven of the chefs were willing to pay more for veal than other reindeer meat. This study shows that it may be possible to introduce reindeer veal as a product with unique qualities in the Norwegian restaurant market. However, as the product seems to be little known in the market, it will be important to make an effort in the marketing of reindeer veal in order to achieve a premium price.
This abstract has previous been published in the abstract booklet from The7th Circumpolar Agricultural Conference, Alta, Finnmark, Norway. September 6-8, 2010. www.bioforsk.no/ikbViewer/Content/72761/Abstracts.pdf (29.10.10)

Reinkalv kjøtt, et unikt produkt?

Morten Heide og Tove Aagnes Utsi
[1]Nofima, Marked, N-9291 Tromsø, Norge (morten.heide@nofima.no). [2]Høgskolen I Finnmark N-9509 Alta, Norge (toveu@hifm.no).

På det norske viltkjøtt markedet er det liten tradisjon for å differensiere mellom kjøtt fra dyr med ulik alder. Et eksempel på dette er reinkjøtt. Selv om mer enn halvparten av reinkjøttet som blir solgt på det norske markedet er kalvekjøtt, blir det ikke gjort noe skille mellom kalvekjøtt og kjøtt fra voksne dyr. Dette er til forskjell fra fårekjøtt som har et skille mellom sau og lam, samt storfekjøtt som har kalvekjøtt som egen kjøttkategori. Hensikten med denne studien var å finne ut om reinkjøtt har unike kvalitetsegenskaper som kan bidra til å differensiere kjøtt fra reinsdyrkalv og voksen dyr. For å undersøke dette ble det rekruttert 30 kjøkkensjefer fra restauranter i Oslo, Stavanger, Tromsø og Alta. Alle fikk utlevert blindprøver av ytrefilet av reinkalv og voksen simle for å finne forskjeller både før og etter tilberedning. Resultatene viser at kalvekjøttet blir oppfattet til å ha en lysere farge, mildere vilt smak og en mørere konsistens enn kjøttet fra voksne dyr. Mer enn 50% av kjøkkensjefene var positive til å kjøpe reinkalvkjøtt om det ble tilgjengelig, men bare 7 av kjøkkensjefene var villig til å betale mer for reinkalvkjøtt enn for annet reinkjøtt. Denne studie viser at det kan være mulig å introdusere reinkalvkjøtt som et unikt produkt på det norske restaurant markedet. Siden reinkalvkjøtt er lite kjent i markedet vil det være viktig å vektlegge markedsføring, for på denne måten å oppnå en høyere pris enn for reinkjøtt generelt.

Dette sammendraget har tidligere vært publisert på engelsk i abstract samlingen til The 7th Circumpolar Agricultural Conference, Alta, Finnmark, Norway. September 6-8, 2010. www.bioforsk.no/ikbViewer/Content/72761/Abstracts.pdf (29.10.10)

Who cares at what cost? Induced orphaning reveals post-weaning maternal care in reindeer

Øystein Holand[1*], Robert B. Weladji[2], Atle Mysterud[3], Knut Røed[4], Eigil Reimers[5], & Mauri Nieminen[6]

[1]Norwegian University of Life Sciences, Department of Animal and Aquacultural Sciences, P. O. Box 5003, NO-1432 Ås, Norway email:oystein.holand@umb.no, [2]Concordia University, Department of Biology, 7141 Sherbrooke St. West Montreal, QC H4B 1R6 Canada, [3]Centre for Ecological and Evolutionary Synthesis, Department of Biology, University of Oslo, P.O. Box 1066 Blindern, NO-0316 Oslo, Norway, [4]Department of Morphology, Genetics and Aquatic Biology, Norwegian School of Veterinary Science, P. O. Box 8146, Dep. NO-0033 Oslo, Norway, [5]Department of Biology, University of Oslo, P.O. Box 1066 Blindern, NO-0316 Oslo, Norway, [6]Finnish Game and Fisheries Research Institute, Reindeer Research Station, FIN-99910 Kaamanen, Finland.

Little is known about post-weaning maternal care, the potential benefits to offspring and costs to mothers in northern and temperate ungulates. This is a particularly important aspect of their life history as a common by-product of human harvesting is orphaning of calves in autumn. We manipulated orphaning and forage distribution during winter for two herds of reindeer at Kutuharju Field Reindeer Research Station, in Kamaanen, Finland; one on natural pasture and the other supplementary fed to increase level of interference competition. Both herds consisted of females with and without calves at heel and orphaned calves. We measured their survival and somatic losses during winter and distances between individuals within the herds. All females survived the winter and there was no evidence of post-weaning maternal cost in terms of female's mass loss. The winter mortality among calves was negligible and did not differ between orphans as compared to non-orphans. However, non-orphaned calves lost less mass and stayed closer to their mothers than orphans. This tended to be marked in the supplementary fed group where interference competition was more likely due to feed being concentrated both in space and time. Reduced mass loss in non-orphans is therefore most likely due to mothers sharing and defending feeding resources and protecting their offspring from harassment by other herd members during their first winter. We conclude that in addition to the ethical dimension of orphaning, hunting practise of northern and temperate ungulates where females having calf/calves at heel are intentionally or non-intentionally harvested, may have demographic consequences.

Simleløse kalver taper meir vekt gjennom vinteren enn kalver som har mora til stede i flokken

Det er lite kjent hvorvidt mora tar seg av kalven første vinter, om dette gir seg utslag i kalvens overlevelse og vekttap gjennom vinteren og om dette er forbundet med kostnader for mora hos nordlige hjortedyr. Dette er spesielt viktig siden mora kan bli skutt fra kalv i løpet av haustjakta. Dersom dette skjer må kalven klare seg sjøl gjennom første vinter. Vi manipulerte flokksammensetninga og fødetilgangen til to reinsflokker ved Kutuharju Feltforskningsstasjon for Reindrift, i Kamaanen, Finland. Begge flokkene besto av simler med og uten kalver, samt morløse kalver. Den ene flokken blei tilleggsfôra med ensilert gras (rundballer) og kraftfôr, mens den andre flokken blei sluppet på naturbeite. Alle simlene overlevde vinteren og det var ingen indikasjoner på at simla investerte i kalven gjennom vinteren, da vekttapet var likt for simler med og uten kalv. Vektnedgangen varierte heller ikke med fôring. Vinterdødeligheten av kalv var låg og varierte ikke mellom de to flokkene, ei heller mellom morlause kalver og kalver der mora var i flokken. Imidlertid tapte morlause kalver meir vekt og holdt seg i utkanten av flokken sammenlikna med kalver med mor til stede. Forskjellen var tydeligst i flokken som blei tilleggsfôra, sannsynligvis grunna forstyrrelseskonkurranse ved fôringsplassen der maten var konsentrert i tid og rom. Vi tror det reduserte vekttapet blant kalver med mor i flokken skyldes at simla deler føderessurser, samtidig som simla verner egen kalv mot trakassering fra andre flokkmedlemmer gjennom første vinter. Vi konkluderer med at, i tillegg til de etiske sider ved å skyte mor fra kalv under jakt, kan dette få demografiske konsekvenser.

Reindeer husbandry and protected areas

Arvid Holte[1] & Jan Åge Riseth[2]
[1]Arvid Holte Consultants, 2624 Lillehammer (arholte@online.no). [2]Norut Northern Research Institute Tromsø & Sami University College, P.O. Box 250, N-8504 Narvik, Norway (janar@norut.no).

The intention of the project is to investigate the reindeer husbanders' experience with protected areas in Norway, i.e. national parks and landscape protection areas used by reindeer husbandry (preferentially the Sami) and propose moves for an increased mutual benefit for protected areas and reindeer husbandry. The methods of the project has been landscape surveys, participant observations and interviews with different actors, and a larger questionnaire for affected reindeer managers, people from reindeer pasture districts (including single siidas or herding groups) and the concession reindeer companies (none-Sami reindeer husbandry in southern Norway). In the second part of the project, there was a wider perspective: to propose what was to be done to get protected areas to be real protection areas for the culture of reindeer husbandry and for nature conservation. In the reports the outcome is described and disseminated in text, maps, tables and list of proposed actions. The main conclusion is that Norway have to change its understanding of IUCN's (The International Union for Conservation of Nature) arrangements for protected areas including criteria and categories and establish a concept PARK OF TRADITIONAL USE to give possibilities to safeguard the land requirements of reindeer husbandry for the better advancement of both reindeer husbandry and nature protection.

Reindrift og områdevern

Arvid Holte[1] & Jan Åge Riseth[2]
[1]Arvid Holte konsulentfirma, 2624 Lillehammer (arholte@online.no). [2]Norut Tromsø & Samisk høgskole, P.O. Box 250, N-8504 Narvik, Norway (janar@norut.no).

Problemstillingen og hensikten med prosjektet er å forstå og formidle reindriftas erfaringer med områdevernet i Norge, dvs. nasjonalparker og større landskapsvernområder som brukes av tamreindrifta (fortrinnsvis den samiske) i landet, og ikke minst å komme med forslag til hvilke grep en kan og bør gjøre for at områdevernet og reindriftas bruk kan være til større gjensidig nytte enn i dag. Prosjektets metoder har vært befaringer, deltakende observasjon og samtaler med ulike aktører, samt en større spørreundersøkelse med berørte reindriftsutøvere, representert ved reinbeitedistrikter, tamreinlag og enkeltsiidaer. I del 2 av prosjektet var mandatet å komme med forslag til hva som må gjøres med områdevernet for at dette skal fungere som et virkelig arealvern for reindriftsnæringen til opprettholdelse av reindriften som næring og livsform. Resultatene er beskrevet og formidlet i tekst, kart, tabeller, bilder og liste over forslag til tiltak. Hovedkonklusjonen er at under forutsetning av at Norge endrer forståelsen av den Internasjonale Naturvernunionens opplegg for områdevern med kriterier og kategorier, og innfører et nytt vernebegrep, benevnt av prosjektet som TRADISJONSBRUKSPARK, vil verneområdene i Norge kunne utvides til fordel for både reindrift og områdevern og slik sikre reindriftas arealbehov i framtida på en bedre måte enn i dag.

Sources – Kilder

A. Holte. Reports 1 and 2 of the project "*Reindrift og områdevern*" 2005-2009.
J.Å. Riseth, & A. Holte. 2008. Rennäring och nationalparker i Norge. Chapter 13 (pp. 269-290) in Sandström, C., S. Hovik, & E. I. Falleth. (eds.) *Omstridd natur. Trender och utmaningar i nordisk naturförvaltning*. Borea, Umeå.

Methods for assessing large and irreversible constructions, military -, public - and commercial activities in reindeer pasture areas

Arvid Holte
Arvid Holte Consultants, 2624 Lillehammer (arholte@online.no).

The poster shows modifications of an impact assessment method prepared in a thesis at the University of Trondheim, A. Holte: "Reindeer Husbandry and Impacts of Hydro Power Constructions – An Attempt of Method", University of Trondheim, 1983. The simplified version of the method was adapted and used in reindeer husbandry reports in Collected Plan for Watercourses. The most extensive version was prepared for larger concession applications of hydropower projects. The method should also be relevant currently because the area conflicts and the pressure on reindeer grazing lands are larger than maybe ever (e.g. windmill fields and other encroachments of the pastures). A short description of the method is as follows:

I. Inventory part. The inventory needs to be extensive and provides opportunities for assessing both direct and indirect consequences in different time perspectives. The template is the following:

A. Delimitation of reindeer management system
B. Nature resource base, including aspects of topography, geology, climate and pasture
C. Outer frames for reindeer husbandry in the area
D. Reindeer husbandry in the reindeer management system (including maps of dynamic land-use of reindeer management).
E. Description of the planned encroachment

II. Impact assessment part. The impacts are described within four dimensions:

1. Certain - probable - possible
2. Preliminary - long term - permanent
3. Physical - operational - social/economic
4. Primary - secondary

The impacts are analyzed in a 3 step procedure (further explanation at the poster).
Finally the impacts are assessed related to the value of the land for reindeer husbandry based on a system of main criteria and sub criteria where the main criteria are:

I. Production value
II. Use value
III. Culture value /identity value

When protection or development is to be recommended (eventually adapted development to minimize damage as much as possible), it must be clarified which value premises the recommendation is based on, where the evaluation process of recommendation of conservation or development follow this procedure:
OBJECTIVES for reindeer management → VALUE CRITERIA for THE AREA → CONSEQUENCES of the encroachment → final ASSESSMENT conservation/ not conservation

The question whether the chosen goal for the actual reindeer management is threatened by the expected impacts of the encroachment, is the decisive. A schematic overview of this procedure is displayed at the poster.

Metoder for å vurdere store og irreversible arealinngrep og aktiviteter i reindriftsnæringens beite- og driftsområder

Arvid Holte
Arvid Holte konsulentfirma, 2624 Lillehammer (arholte@online.no).

Posteren viser en vurderings- eller konsekvensanalysemetode som jeg utviklet i en hovedoppgave i geografi fra Universitetet i Trondheim, 1983 ("Reindrifta og virkninger av kraftutbygging - et metodeforsøk"). Det enkleste trinn av metoden ble tilpasset og benyttet i arbeidet med reindrifts-utredningene i Samlet Plan for vassdrag. Den mest utfyllende versjonen ble utarbeidet for større konsesjonssøknader av vannkraftprosjekter. Metoden burde fortsatt ha stor aktualitet i det både tradi-sjonelle og nye arealkonflikter er økende, og presset på reindriftarealene større enn kanskje noen gang før (jf. vindmølleindustrifelt og andre utbyggingsprosjkter, f.eks. kraftlinjer).
Metoden er kort beskrevet i det følgende:

I. Registreringsdel. Registreringene må være omfattende og gi mulighet for både å vurdere direkte og indirekte virkninger i ulike tidsperspektiv. Malen er følgende:
- A. Avgrensning av reindriftssystem
- B. Naturgrunnlaget, både topografiske, geologiske, klimatiske og beitemessige forhold
- C. Ytre rammer for reindrifta i området
- D. Reindrifta i reindriftssystemet (bl.a. med kartframstilling av reindrifttas dynamiske arealbruk i området)
- E. Beskrivelse av det planlagte inngrepet

II. Konsekvensvurderingsdel. Virkningene beskrives etter fire dimensjoner:
1. Sikre - sannsynlige - mulige
2. Forbigående - langsiktige - varige
3. Fysiske - driftsmessige - sosiale/økonomiske
4. Primære - sekundære

De analyseres etter en prosedyre i tre trinn (blir nærmere forklart på posteren).
Til slutt vurderes virkningene i forhold til verdien av arealene i reindrifta etter et system av hovedkriterier og underkriterier hvor hovedkriteriene er:
- I. Produksjonsverdi
- II. Bruksverdi
- III. Kulturverdi/identitetsverdi

Når det så skal tilrås vern eller utbygging (evt tillemping av utbygging for å forårsake minst mulig skade), må det klargjøres hvilke verdipremisser som ligger til grunn for tilrådningen, hvor evalueringsprosessen fram til tilråding av vern eller utbygging følger denne prosedyren:

MÅL for reindrifta → VERDIKRITERIER for området → inngrepets
KONSEKVENSER → endelig VURDERING vern/ikke vern.

Spørsmålet om det valgte målet som er satt for den aktuelle reindrifta i området trues ut fra de antatte konsekvenser av inngrepet, er det avgjørende. Skjematisk oversikt av denne prosedyren vises på posteren.

The reindeer as barometer – to use traditional ecological knowledge among reindeer herding Sami of reindeer behavior as an indicator on climate changes

Berit Inga
Ajtte Swedish Mountain and Sami Museum, Box 116, S-962 23 Jokkmokk and Abisko Scientific Research Station, S-981 07 Abisko, Sweden (Berit.Inga@ajtte.com).

The aim of this study is to investigate if there are changes in the reindeer' behavior observed through the reindeer herdsmen knowledge on the animal that can be explained by changes in the climate. The hypothesis is that reindeer herdsmen generally have acquired a good knowledge through experience and "inherited" knowledge how the reindeer uses the landscape during the year and at different weather circumstances, and by making interviews with reindeer herders, it will be possible to map changes in the migratory behavior of domesticated reindeer and how they have used the land at least the last 50 years.
Comparing certain corrals in the reindeer herding community (sameby) today and older corrals can give us useful indications on how the behavior of the reindeer has changed. Such data can be compared with the climate data that are collected in the Abisko area since 1913, to see what connection there are between climate changes and the reindeer habits of life.
From the interviews and investigations, a number of areas that reindeer often utilized under certain climate conditions will be selected for further investigations. The results from the different areas will be evaluated by comparing them to climate data and historical documents. Lastly, the reindeer herders will be interviewed how they think the climate influence impacts reindeer herding methods, pasturage accessibility, and seasonal use of grazing lands and how the reindeer industry will adapt.

Renen som en barometer – att använda traditionell ekologisk kunskap hos renskötande samer om renens beteenden som en indikator på klimatförändringar

Målet med studien är att undersöka om det är möjligt att använda renens beteenden och observerade förändringar i beteendet som en indikator på klimatförändringar via renskötarnas kunskap om renen. Hypotesen är att renskötare generellt har en god kunskap om renens beteenden och hur renen använder landskapet under året och under olika klimat förhållanden. Genom att intervjua renskötare kan vi rita en detaljerad karta över hur renarna har nyttjat markerna under åtminstone de senaste 50 åren.
Studier av de rengärden som används av dagens renskötare, och av äldre gärden och deras historia kan ge värdefulla indikationer på hur renarnas beteenden förändrats genom tiderna. Detta kan sedan jämföras med de klimatdata som samlats in i Abisko-området sedan 1913 för att avgöra vilka samband som finns mellan förändringar i klimatet och renarnas levnadsvanor.
Utifrån intervjuerna och undersökningarna väljes ut ett antal områden där renarna gärna uppehåller sig under vissa väderbetingelser. Dessa närstuderas med avseende på nyttjandegrad nu och förr, vilka betesväxter som finns i området samt hur terrängen ser ut. Studierna av de olika områdena utvärderas, bland annat genom jämförelser av klimatdata och studier av eventuella fotografier från början av 1900-talet.
Som siste del av studien genomförs intervjuer med renskötare om deras funderingar kring klimatpåverkan på renskötselmetoder, påverkan på betestillgången och hur de olika årstidsbetesmarkerna påverkas, hur kan rennäringen anpassa sig till ett varmare klimat? Syftet med studierna är att se om det finns förändringar av renens beteende med avseende på tidpunkten för brunst, kalvning och andra iakttagna anpassningar som kan förklaras bero av klimatförändringar.

Is the snow structure changing? Results from snow structure observations in Abisko scientific research station, Sweden

Cecilia Johansson
Department of Earth Sciences, Air, Water and Landscape Science, Uppsala University, Geocentrum, Villavägen 16, SE-752 36 Uppsala, Sweden (Cecilia.Johansson@met.uu.se).

The climate at high latitudes is changing, and the observed changes are occurring with a higher rate compared to more southerly latitudes (ACIA, 2005). Especially temperature has been studied, but at high latitudes snow conditions has a big influence on the climate and is a very important feedback mechanism in the climate system. Earlier studies concerning climate change and snow, has mainly focused on snow cover and snow depth. The snow cover seems to be generally decreasing but snow depth show regional areas with increase and other areas with decreasing snow depth. However also the inner structure of the snowpack is important, but is much less studied due to lack of long term observations. For example reindeers are affected by the snow structure when it comes to finding food under the snow (e.g. amount of ice layers and the thickness of individual ice layers in the snow pack), but also plants and other animals are highly affected by the snow structure. With a warmer climate how will the snow structure be affected?

Within the ISIS project (Interpretation and evaluation of snow and ice from remote sensing using local and scientific expertise) the inner snow structure of the snowpack has been studied using a unique data set from the Abisko Scientific Research Station (ASRS), Abisko, Sweden. At ASRS snow stratigraphy observations have been made every second week during the winter season since autumn 1961 until present. Ordinary meteorological snow observations consist of snow cover and snow depth. At ASRS also layering within the snowpack has been recorded and for each individual layer grain size, snow layer hardness, grain compactness and snow layer dryness.

To investigate changes in the snow features the dataset was divided into three time periods, 1961-1976, 1977-1992, and 1993-2009. The total number of ice hard layers for the tree time periods has increased slightly from the first period to the last. However there is no trend in the observations indicating that the number of ice hard layers in the individual snowpack is changing. The same is true for the summed thickness of ice hard layers in the individual snowpack observations.

In the last time period (1993-2009) snow profiles with a 1 cm thick ice hard layer has doubled compare to the time periods before. The same is true for the total cumulative amount of ice hard layers in each time period, which has increased from 5% up to 10% of the total snowpack thickness from the first two periods to the last.

The positioning of the ice hard layers has also changed between the tree time periods. In the last time period the ice hard layers are more frequently found in the lower part of snow profile (i.e. close to the ground). The number of occasions with ice hard layers at ground level has increased 3-4 times the number found during 1961-1976 and 1977-1992.

To summarize, there has been a change in snow layer hardness observed in the snow profiles from the first two time periods compared to the last time period. Thin ice hard layers have become more frequent and the probability for ice hard layer forming close the ground has increased drastically. This change in snow layer hardness correlates well with the increase in temperature recorded at ASRS. Hence conditions with ice hard layers close to the ground will most likely increase with global warming.

References

ACIA, (Arctic Climate Impact assessment). 2005. *Arctic ClimateImpact Assessment 2005*. Cambridge: Cambridge University Press.

Håller snön sammansättning på att ändras? Resultat från snöprofilobservationer utförad vid Abisko naturvetenskaliga forskningsstation, Sverige

Cecilia Johansson
Institutionen för geovetenskaper, Luft-, vatten- och landskapslära, Uppsala universitet, Geocentrum, Villavägen 16, 752 36 Uppsala, Sverige (Cecilia.Johansson@met.uu.se).

Klimatet på höga latituder håller på att förändras och observationer visar att denna ändring sker snabbare på högre latituder jämfört med mer sydliga (AICA, 2005). Stort fokus har tidigare lagts på att undersöka hur temperaturen har förändrats, men på höga latituder så är även snöförhållandena viktiga för klimatet. Tidigare studier som berör just snöförhållanden har fokuserat på snöutbredning och snödjup. Resultaten visar att snöns utbredning minskar, medan snödjupet i vissa områden har ökat och på andra områden har avtagit. Däremot finns det ytterst lite undersökt när det gäller snöns sammansättning (vertikala struktur), vilket beror på att det saknas långtidsobservationer. Snöns struktur påverkar bl.a. renars möjlighet att finna mat under vintern, men även andra djur och växter påverkas. Frågan är hur snöns sammansättning har och kommer att påverkas av ett varmare klimat.

Inom projektet ISIS (Tolkning och utvärdering av snö och is m.h.a. fjärranalys genom användning av samisk och vetenskaplig expertis) har snöns sammansättning undersökts från observationer utförda på Abisko Naturvetenskapliga forskningsstation (ANS), Sverige. På ANS har observationer av snöstrukturen gjorts varannan vecka under vinterperioden sedan vintern 1961 och pågår fortfarande. Vanliga meteorologiska observationer av snö ger information om snötäcket och mängden snö. ANS observationer beskriver hur skiktningen i snön ser ut (d.v.s. antal olika snölager inom snöpacken) samt för varje individuellt lager kornstorleken på snön, hur hårt snölagret är, hur kompakt snökornen är och hur torrt snölagret är.

För att undersöka snön ur en klimatologisk synvikel har observationerna delats upp i tre tidsperioder: 1961-1976,1977-1992 och 1993-2009. Resultaten visar att antalet ishårda skickt i snön har ökat något från den första till den sista tidsperioden. Däremot finns det ingen trend som visar på att det skulle blivit fler islager per individuell snöprofil (däremot fler snöprofiler med ishårda skikt i). Analysen visar inte heller på att tjockleken av de shårda skikten per profil skulle ha blivit tjockare. Däremot är det tydligt att under perioden 1993-2009 så har antalet tunna islager (1 cm tjocka) fördubblats jämfört de två tidigare perioderna. Det samma gäller för den totala tjockleken islager (alla cm islager summerat per tidsperiod) som har ökat från att utgöra 5% i de två första perioderna till 10% i den sista.

Var i snöpacken som man finner islager har också förändrats. Observationerna visar att under den senaste perioden har islager i den nedre delen av snön ökat (nära markytan). Antalet tillfällen med is vid markytan har under perioden 1993-2009 ökat med 3-4 gånger jämfört de två första tidsperioderna.

Sammanfattningsvis så visar observationerna på att snöns sammansättning har ändrat karaktär från de två första tidsperioderna jämfört med den sista. Tunna islager/skarskikt har blivit vanligare och sannolikheten för ishårda skikt vid markytan har ökat drastiskt. Dessa förändringar i snöns struktur följer väl den observerade ökningen i temperatur vid ANS. Så om temperaturklimatet i framtiden kommer att följa det uppmätta klimatet under perioden 1993-2009 eller om vi får ytterligare temperaturhöjning så kommer sannolikehten för ishårda skikt i marknära skikt att fortsätta vara hög eller eventuellt även att öka i förekomst i framtiden.

References:
ACIA, (Arctic Climate Impact assessment). 2005. *Arctic Climate Impact Assessment 2005*. Cambridge: Cambridge University Press.

Potential effects of temperature increase on forest distribution on Finnmarksvidda, North Norway

Stein Rune Karlsen[1], Bernt Johansen[1], Hans Tømmervik[2], Jan Åge Riseth[1], & Ingunn Ims Vistnes[3]

[1]Norut, Northern Research Institute Tromsø, N-9294 Tromsø, Norway Norway (stein-rune.karlsen@norut.no; bernt.johansen@norut.no;, jan.age.riseth@norut.no).
[2]Norwegian Institute for Nature Research (NINA), Fram Research Centre, N-9296 Tromsø, Norway (hans.tommervik@nina.no).
[3]Norut, Northern Research Institute Alta, N-9506 Alta, Norway (ingunn.vistnes@norut.no).

Background

The study area, Finnmarksvidda in northernmost Norway, is a large and gently undulating plateau located partly to the low alpine and partly to the northern boreal vegetation zone (Fig. 1). Most of the current non-wooded area is situated between the current birch forest limit and the birch timberline, and therefore might undergo considerable vegetation changes in terms of increased forest cover in a warming climate. The predicted and also to some extent realized consequence of global warming is the spread of birch forests to the tundra and its low-alpine fringes. Recent research results show that shrub encroachment and tree invasion on the tundra have been much more rapid than previously expected (Kullman, 2002; Tømmervik et al., 2009). As compared to open heaths and grasslands, low forests and scrublands convert much higher fraction of incoming solar radiation to heat (Chapin et al., 2005). On top of this, scrubland and woodland expansion will speed up snowmelt, which has huge impact on the energy balance of northern land areas. Global warming may thus become a self-perpetuating vicious circle.

The aims of this study are to simulate potential increase in forest cover after a 1 °C increase of mean summer temperature, and then to discuss potential consequences for the reindeer herding.

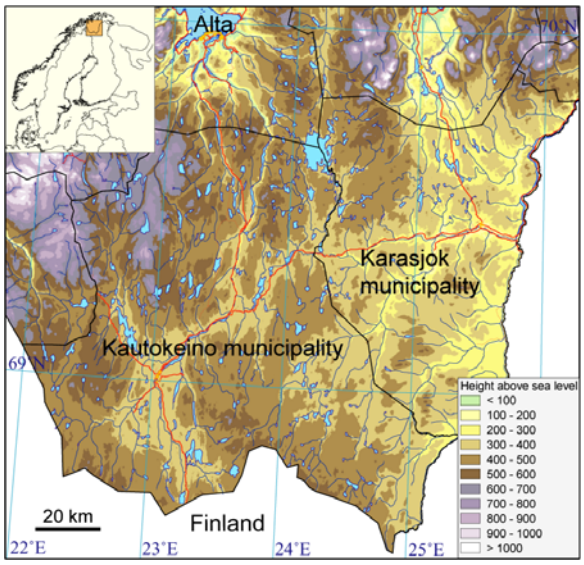

Fig. 1. A terrain model of the study area. The current tree line is formed by birch and is mostly between 420 and 480 meters altitude.

Material and methods

The study uses a vegetation map of Finnmarksvidda (Fig. 2a). The vegetation map is developed from Landsat TM satellite data from the year 2006 (Johansen & Karlsen, 2007). The method is based on an extensive study on Varangerhalvøya peninsula, north-easternmost Norway, where Karlsen et al. (2005) developed a method for using vegetation types for climatic mapping. In this study we use the classification of the vegetation types into temperature groups and habitat preferences. The mapped vegetation types on Finnmarksvidda were grouped according to their minimum temperature prefe-

rences, in groups with steps of 4 °C differences in biotemperature, which correspond to approximately 1 °C in differences in July temperature of the area. Then we assume that the current positions of the vegetation types on Finnmarksvidda are in balance with climatic factors. We also assume that a 1 °C decrease correspond to a 171 m altitude increase, based on a decrease on 0.585 °C/100 m (Tveito et al., 2000). Finally, we did a static linear modelling of potential forest distribution after a 1 °C increase in mean July temperature.

Results and discussion

Fig. 2 displays the current and simulated future vegetation on Finnmarksvidda. The simulation indicates potentially dramatic changes in vegetation due to a one-degree temperature increase. In Karasjok municipality the forested areas will potentially increase from 62% to 86%, and such changes will cause a reduction in the heaths and meadows from 23% to less than 1%. In particular, the pine forest, the mixed pine-birch forests and the bilberry/meadows forest units will increase in Karasjok. In Kautokeino municipality the forested areas will almost double, from 36% to 71%, and correspondingly the heaths and meadows will be reduced from 39% cover to less than 7%. The crowberry birch forest shows the largest increase from 12% to 31% cover. Totally, for Karasjok and Kautokeino municipalities, the forested areas will increase by 4640 km^2 (from a current 6898 km^2 to a simulated 11537 km^2).

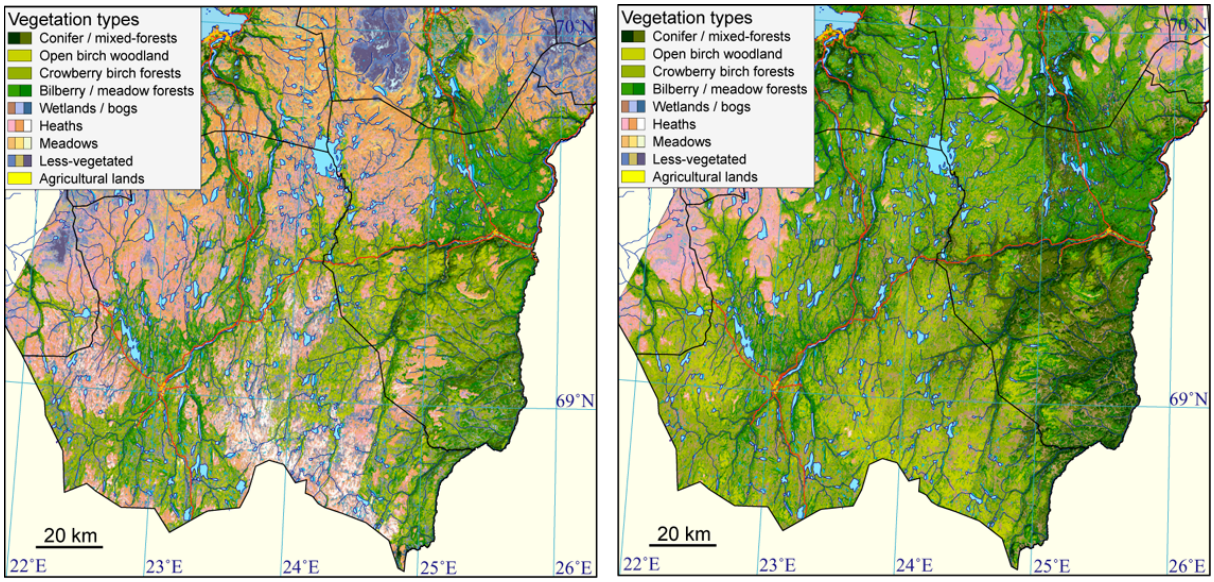

Fig. 2. (a) Current vegetation, redrawn from Johansen & Karlsen (2007). (b) A scenario map showing simulated potential forest distribution at 1°C increase of July temperature.

The simulation has the limitation that temperature is the only factor used in the modelling, and that it assumes a current forest distribution in equilibrium with climate. There will also be local differences to which extent these changes will take place according to variations in soil conditions, insect outbreaks, and grazing pressure. However, the simulation results can be used as a scenario tool. The next step in the project is to consider the potential effects for the reindeer herding, but this work remains to be done.

Acknowledgements

This study is financed partly by The Norwegian Reindeer Administration Authorities, ‘‘Development Fund of Reindeer Husbandry", and partly by Norut Tromsø, within the strategic institute programme ‘‘New and improved remote sensing techniques for environmental monitoring’’ (EnviMon).

(References after the Norwegian version)

Potensiell fremtidig skogsutbredelse på Finnmarksvidda som en følge av temperaturøkning

Stein Rune Karlsen[1], Bernt Johansen[1], Hans Tømmervik[2], Jan Åge Riseth[1] & Ingunn Ims Vistnes[3]

[1]Norut, Northern Research Institute Tromsø, N-9294 Tromsø, Norway Norway (stein-rune.karlsen@norut.no; bernt.johansen@norut.no;, jan.age.riseth@norut.no).

[2]Norwegian Institute for Nature Research (NINA), Fram Research Centre, N-9296 Tromsø, Norway (hans.tommervik@nina.no).

[3]Norut, Northern Research Institute Alta, N-9506 Alta, Norway (ingunn.vistnes@norut.no).

Bakgrunn

Finnmarksvidda ligger hovedsaklig i overgangen mellom den nordboreale og lavalpine vegetasjonssone. Mesteparten av områdene uten skog i dag befinner seg mellom skogsgrensen og tregrensen (420-480 m.o.h.), og derfor kan skogen ekspandere mye under ett varmere klima. Nyere forskning har vist at invasjon av busker og trær i de subarktiske og alpine områder har skjedd raskere enn tidligere antatt (Kullman, 2002; Tømmervik et al., 2009). Skog- og buskvegetasjon konvertere mer av den innkommende solstrålingen til varme i forhold til åpne hei-samfunn (Chapin et al., 2005). Dette gjør at et varmere klima fører til en selvforsterkende prosess. Målet med dette studiet er å modellere potensiell skogsutbredelse på Finnmarksvidda ved en 1 °C økning av sommertemperaturen, og deretter å diskutere effekten det har for reindriftsnæringen.

Materiale og metoder

Studiet tar utgangspunkt i et vegetasjonskart fra 2006 (fig. 2a i engelsk versjon), som er utviklet basert på data fra Landsat satellittene (Johansen & Karlsen 2007). Modelleringen av fremtidig skogsutbredelse er basert på ett omfattende studie på Varangerhalvøya, lengst nordøst i Norge, hvor Karlsen et al. (2005) utviklet en metode for å bruke vegetasjonstyper i klimakartlegging. I dette studiet inndeler vi alle vegetasjonstyper på Finnmarksvidda i temperaturgrupper og etter habitatkrav, etter modell fra Varangerhalvøya. Vi inndeler alle vegetasjonstyper etter deres antatte minimums temperaturkrav, i grupper med differanse på 4 °C i biotemperature, som tilsvarer omtrent 1 °C i juli middeltemperatur. Deretter antar vi at dagens vegetasjon og skogsutbredelse er i balanse med dagens klima. Vi antar også at 1 °C endring korresponderer med 171m høydeforskjell, basert på en temperaturnedgang på 0,585 °C per 100 meter høydeforskjell (Tveito et al., 2000). Til slutt gjør vi en statisk lineær modellering av potensiell skogsutbredelse basert på en 1 °C økning av juli middeltemperatur.

Resultat og diskusjon

Fig. 2 (se engelsk versjon) viser dagens og potensiell fremtidig vegetasjon på Finnmarksvidda. Modelleringen viser en potensiell dramatisk endring i vegetasjonen som en følge av en 1 °C økning av sommertemperaturen. I Karasjok kommune vil skogsutbredelsen øke fra dagens 62% til en fremtidig 86% dekning, og tilsvarende vil hei- og engvegetasjon reduseres fra dagens 23% til mindre enn 1% dekning. Det er særlig furuskogen, blandingsskogen furu/bjørk og blåbær-/engbjørkeskogen som vil øke i areal i Karasjok kommune. I Kautokeino kommune vil skogsarealet nesten fordobles, fra dagens 36% til fremtidig 71% dekning, og tilsvarende vil hei- og engvegetasjon reduseres fra 39% til mindre enn 7% dekning. Spesielt bjørkeskog av kreklingtypen vil øke mye i areal i Kautokeino (fra dagens 12% dekning til 39% i fremtiden). Totalt for Finnmarksvidda (Karasjok og Kautokeino kommune) vil de skogskledde områder øke med 4640 km^2 (fra dagens areal på 6898 km^2 til fremtidig 11 537 km^2).

Modelleringen har den begrensning at temperatur er den eneste faktor som det er tatt hensyn til, og at dagens skogsutbredelse er i balanse med dagens klima. Det vil helt sikkert bli lokale forskjeller i hvor fort skogen vil bre seg utover - alt etter variasjon i jordmonn, lauvmakkutbrudd, nedbør og beitepress. Men vi antar at modellering kan brukes som ett verktøy i scenarier. Neste steg i prosjektet er å diskutere hvilke effekter denne endringen i skogsutbredelsen vi ha å si for reindriften, men dette arbeidet gjenstår.

Takk

Prosjektet er delvis finansiert av Reindriftens Utviklingsfond og delvis av Norut Tromsø sitt strategiske instituttprogram "New and improved remote sensing techniques for environmental monitoring (EnviMon)".

Referanser - References

Chapin, F.S. III. et al. 2005. Role of land-surface chnages in artic summer warming. *Science*, 310: 657-660.

Johansen, B. & S.R. Karlsen. 2007. *Finnmarksvidda - kartlegging og overvåkning av reinbeiter - status 2006*. Norut IT Rapport IT394/1-2007. 47 sider.

Karlsen, S. R., A. Elvebakk, & B. Johansen. 2005. A vegetation-based method to map climatic variation in the arctic-boreal transition area of Finnmark, north-easternmost Norway. *Journal of Biogeography*, 32:1161-1186.

Kullman, L. 2002. Rapid recent range-margin rise of tree and shrub species in the Swedish Scandes. *Journal of Ecology*. 90:68-77.

Tveito, O.E., E. Førland, R. Heino, I. Hanssen-Bauer, H. Alexandersson, B. Dahlström, A. Drebs, C. Kern-Hansen, Y. Jónsson, E. Vaarby Laursen & Y. Westman. 2000. *Nordic temperature maps*. DNMI Report 09/00, Oslo, Norway.

Tømmervik, H., Johansen, B., Riseth, J.Å., Karlsen, S.R., Solberg, B., & K.A. Høgda. 2009. Above ground biomass changes in the mountain birch forests and mountain heaths of Finnmarksvidda, Northern Norway, in the period 1957-2006. *Forest Ecology and Management*, 257: 244-257.

Which factors explain the amounts of ground lichens on reindeer pastures?

Jouko Kumpula[1] & Mika Kurkilahti[2]
Finnish Game and Fisheries Research Institute, Kaamanen[1] and Turku[2], FI-99910 Kaamanen and FI-20520 Turku, Finland (jouko.kumpula@rktl.fi and mika.kurkilahti@rktl.fi).

During the past decades, the reindeer pasture environment in Finland has went through several changes where the quantity both of ground lichens and arboreal lichen pastures have decreased while the different forms of land use have intensified and expanded. This development has increasingly forced reindeer management away from the traditional herding and management practices. Regardless of several large-scaled changes in pasture environment, changes in the conditions of lichen ranges have been considered to be mainly effects of reindeer management. We can suppose, however, that the amounts and growth rates of lichens on reindeer pastures are regulated by several factors whose effects are still poorly known.

We investigated the amounts of ground lichens and their changes in the 20 northernmost reindeer herding districts in Finland using the reindeer pasture inventory data and statistical modelling. During the years 2005-2008 altogether 625 field sites located on lichen ranges were studied in that area. Also the amounts of different winter pasture types as well as the total area covered and affected by infrastructure (population and tourist centres, buildings, roads, different routes, mining areas etc.) were mapped within each herding district. We were able to find changes in the amounts of lichens between two inventories by using 325 field sites also studied in 1995-1996. Effects of the different factors on the standing biomass of lichens and its changes on lichen ranges were analysed using the linear mixed models whose suitability for the data was also tested. On the basis of the models, several factors were found to affect the standing biomass of lichens in 2005-2008 and its changes between two inventories.

The higher was the long term reindeer density on lichen ranges (reindeer/km^2) the smaller biomass of lichens was measured. However, biomass of lichens was clearly higher on the winter pasture areas separated by a pasture rotation fence compared with the pasture areas used in all year round or in summer. The greater the proportion of arboreal lichen pasture (mature and old growth coniferous forests) in the district the higher biomass of ground lichens was also measured on lichen ranges. On the pine dominated lichen ranges, the highest lichen biomass was found in old growth forests, while the lowest biomass was measured in forests under 80 years old. However, the smallest amounts of lichens were measured both on dry mountain heaths and similar birch forests. The higher the proportion of the area covered and affected by the infrastructure in the district the smaller amounts of lichens were also discovered. Within the zone 80 km from the metal industrial complex of Nikel in Russia (i.e. eastern Inari and Utsjoki), the biomass of lichens was clearly smaller compared with more distant areas. The average biomass of lichens (kg/ha) on the field sites located in lichen ranges was reduced by half between the years 1995-1996 and 2005-2008 and the reduction was the larger the higher reindeer densities on lichen ranges and the smaller proportion of arboreal lichen pastures in the district.

In the large and complex ecosystems of pasture environment, there are several factors affecting directly or indirectly the state of pastures and the amounts of food plants. Reindeer management itself and forest harvesting, tourism, mining, settlements etc. all appear in the state, deterioration and usability value of pastures as well as in the amounts and location of food plants on pastures. The long carried pollutants from different emission sources will also affect the amount and growth rate of ground and arboreal lichens. However on pastures, effects of different factors vary in different areas. Noticing and monitoring effects of all these factors will make it possible to take actions in improving the state of pastures. Also for the reindeer herding environments there will obviously be needed more versatile and politically more comprehensive “regime plans for reindeer pastures”.

Mitkä tekijät selittävät maajäkälien määriä porolaitumilla?

Jouko Kumpula[1] & Mika Kurkilahti[2]
Riista- ja kalatalouden tutkimuslaitos, Kaamanen[1] ja Turku[2], 99910 Kaamanen ja 20520 Turku
(jouko.kumpula@rktl.fi and mika.kurkilahti@rktl.fi)

Poronhoidon laidunympäristö on muuttunut viime vuosikymmenien aikana Suomessa monella tavalla jäkälämäärien vähentyessä ja luppolaidunten pinta-alojen pienentyessä samalla kun eri maankäyttömuodot ovat lisääntyneet ja tehostuneet porolaitumilla. Tämä kehitys on ohjannut poronhoitoa yhä enemmän irti perinteisistä hoitokäytännöistä. Huolimatta monista laaja-alaisista muutoksista laidunympäristössä jäkäliköiden kunnon muutoksien on katsottu selittyvän pääosin poronhoidon vaikutuksilla. Voidaan kuitenkin olettaa, että maajäkälien kasvuun ja määriin porolaitumilla vaikuttaa monia sellaisia tekijöitä, joiden vaikutukset tunnetaan edelleen huonosti.

Tutkimme tilastomallinnuksen avulla poronhoitoalueen 20 pohjoisimman paliskunnan jäkälälaidunten jäkälämääriin ja niiden muutoksiin vaikuttavia tekijöitä laiduninventointien aineistoja hyödyntäen. Poronhoitoalueen pohjoisosassa inventointiin vuosina 2005–2008 yhteensä 625 koealuetta ravintokasvien biomassojen selvittämiseksi jäkälälaitumilla. Laiduninventoinnissa kartoitettiin myös erityyppisten laidunten määrät sekä ns. infrastruktuurin (taajamat, turistikeskukset, rakennukset, tiet, reitit, kaivosalueet ym.) peitto- ja vaikutusalueiden laajuus paliskuntien alueilla. Jäkälämäärien muutoksia tutkimuspaliskunnissa laiduninventointien 1995–1996 ja 2005–2008 välillä analysoitiin 334 koealueen perusteella. Eri tekijöiden vaikutusta jäkälämääriin ja niiden muutoksiin laitumilla mallinnettiin lineaaristen sekamallien avulla, joiden luotettavuus aineistoille testattiin.

Mallinnusten perusteella jäkälämääriin jäkälävaltaisilla laitumilla vuosina 2005–2008 ja jäkälämäärien muutoksiin inventointien välillä vaikuttivat useat eri tekijät. Mitä korkeampi pitkäaikainen porotiheys jäkälälaitumilla (eloporoa/km^2) oli, sitä pienempi jäkälämäärä laitumilla mitattiin. Jäkälän määrä jäkäläkankailla oli kuitenkin laidunkiertoaidoilla erotetuilla talvilaidunalueilla selvästi korkeampi kuin ympäri vuoden käytössä olevilla laidunalueilla tai kesälaidunalueilla. Mitä suurempi luppolaidunten (varttuneet ja vanhat metsät) osuus paliskunnan maa-alasta oli, sitä enemmän myös maajäkälää laitumilla mitattiin. Mäntyvaltaisilla kankailla suurin jäkälämäärä mitattiin varttuneissa ja vanhoissa metsissä, pienin alle 80-vuotiaissa metsissä. Vähiten jäkälää oli tunturikoivikoissa ja tunturikankailla. Mitä suurempi infrastruktuurin peitto- ja vaikutusalue maa-alasta oli, sitä pienempi jäkälämäärä laitumilla havaittiin. Vyöhykkeellä (Itä-Inari ja Utsjoki), joka sijaitsee alle 80 kilometrin etäisyydellä Venäjän Nikkelin metalliteollisuuden kompleksista jäkälämäärä oli myös selvästi pienempi kuin sitä etäämpänä sijaitsevalla alueella. Jäkälän keskimääräinen biomassa (kg/ha) laski koealueilla noin puoleen vuosien 1995–96 ja 2005–2008 välillä. Jäkälämäärien vähentyminen seuranta-aikana oli sitä suurempi, mitä korkeammat jäkälälaidunten porotiheydet olivat ja mitä vähemmän maa-alasta oli luppolaitumia. Jäkälämäärien vähentyminen oli myös suurempi sekä ympärivuotisilla että kesälaidunalueilla kuin erillisillä talvilaidunalueilla. Vyöhykkeellä, joka sijaitsee alle 80 kilometrin etäisyydellä Nikkelistä, jäkälämäärien vähentyminen oli myös muuta aluetta selvästi suurempi.

Poronhoidon laidunympäristö muodostaa laajan ja monimutkaisen laidunekosysteemin, jossa porolaidunten tilaan ja ravintokasvien määriin vaikuttavat joko suoraan tai välillisesti useat eri tekijät. Poronhoidon, metsätalouden, matkailun, kaivostoiminnan, asutuksen ym. maankäytön toimilla vaikutetaan laidunten tilaan, käytettävyyteen ja kulumiseen sekä ravinnon määrään ja sen sijoittumiseen laitumilla. Myös kaukokulkeutuneet ilmansaasteet voivat vaikutta joko suoraan tai välillisesti maajäkälien ja lupon määriin laitumilla. Eri tekijöiden merkitys vaihtelee kuitenkin alueittain. Laidunympäristöjen tilaa voidaan ymmärtää ja samalla myös parantaa eniten huomioimalla ja seuraamalla kaikkien näiden vaikutustekijöiden osuutta laidunten tilan muutoksiin. Myös poronhoidon laidunympäristöjen osalta tarvittaisiin siten ehkä kokonaisvaltaisempia ja yhteiskunnallisesti laaja-alaisempia ”porolaidunten hoitosuunnitelmia”.

Satellite remote sensing of snow on reindeer pastures in the Torneträsk region

Eirik Malnes[1], Cecilia Johanson[2], Jan Åge Riseth[1], & Hans Tømmervik[3]
[1]Northern Research Institute (Norut), Tromsø Research Park, N-9294 Tromsø, Norway; (eirik@norut.no), [2]University of Uppsala, Department of Earth Sciences, Air, Water and Landscape Science, Uppsala University, Geocentrum, Villavägen 16, SE-752 36 Uppsala, Sweden (Cecilia.Johansson@met.uu.se), [3]Norwegian Institute for Nature Research (NINA), 9296 Tromsø, Norway (hans.tommervik@nina.no).

Within the frame of the ISIS project funded by the Swedish space centre we have studied the snow cover on the reindeer pastures surrounding the Torneträsk and Altevatn in the border regions between Sweden and Norway with various satellite sensors as well as field measurements and measurements at the Abisko environmental station and several meteorological stations. The satellite data covers a period of five years from 2005 to present using data from ESA'a Envisat ASAR and NASA's Terra MODIS and Quikscat SEAWINDS instruments. The results from the satellite analysis shows that a multisensor multitemporal combination of satellie data can provide valuable spatial information about several aspects of the snow cover, including snow cover fraction, wet/dry snow and snow depth/snow water equivalent. We have studied in detail the potential to use synthetic aperture radar (SAR) to find precensce of liquid water in the snow cover. By combining this information from satellite with meteorological information about temperature, we find areas that are more likely to have ice blocked reindeer pastures than others.

Satellittovervåkning av snø på reinbeiter i torneträskområdet

Eirik Malnes[1], Cecilia Johanson[2], Jan Åge Riseth[1] & Hans Tømmervik[3]
[1]Northern Research Institute (Norut), Tromsø Research Park, N-9294 Tromsø, Norway; (eirik@norut.no), [2]University of Uppsala, Department of Earth Sciences, Air, Water and Landscape Science, Uppsala University, Geocentrum, Villavägen 16, SE-752 36 Uppsala, Sweden (Cecilia.Johansson@met.uu.se), [3]Norwegian Institute for Nature Research (NINA), 9296 Tromsø, Norway (hans.tommervik@nina.no).

Innenfor ISIS-2 prosjektet som er finansiert av det Svenske Rymbdstyrelsen har vi studert snødekket op reinsbeiter i områdene omkring Torneträsk og Altevatn i grenseområdet mellom Sverige og Norge med tre ulike satellittsensorer, samt felt målinger og data fra Abisko feltstasjon og flere meteorologiske stasjoner. Satellittobservasjonene dekker tidsperioden 2005-2010 og vi bruker data fra ESA's Envisat ASAR sensor i tillegg til NASA's Terra MODIS og Quikscat SEAWINDS instrument. Resultatene fra satellitt analysen visar at en multisensor multitemporal kombinasjon av satellittdata kan gi verdifull romlig informasjon flere ulike aspekter ved snødekket, inkludert snøfraksjon, separasjon av våt og tørr snø og informasjon om snødybde eller vannekvivalent. Vi har også studert i detalj hvordan data fra Syntetisk Aperture Radar (SAR) kan utnyttes to å finne våt snø. Ved å kombinere denne informasjonen fra satellitt med meteorologiske temperaturmålinger kan vi detektere områder som er mer utsatt for isblokkering av reinbeiter.

Estimation of maternal effects on weight records of Kutuharju reindeer

Kirsi Muuttoranta[1], Mauri Nieminen[2], & Asko Mäki-Tanila[1]
[1]MTT Agrifood Research Finland, FI-31600 Jokioinen, [2]Finnish Game and Fisheries Research Institute, FI-99910 Kaamanen (Asko.Maki-Tanila@mtt.fi).

The main source of income in reindeer is slaughtered calves. The calf weights varied over the years, they are also affected by sex, birth date and pasture conditions. The genetic factors have also influence on birth weight and growth. The set-up of a selection scheme would require analyses to what extent the growth performance could be altered and how successful selection on the trait would be. The studied data comes from the reindeer at the Kutuharju experimental herd owned by the Reindeer Herders' Association. The Finnish Game and Fisheries Research Institute is carrying out a recording scheme on the experimental reindeer. The data is very unique because it contains also the birth weight records. Coefficient of variation is a very useful parameter in comparing different species or populations. It is providing a variation measure independent of the scale. The coefficient of variation in calf growth was 18% (somewhat smaller in males). The figure for the birth weight was of the same order. The range of variation is rather wide in reindeer when compared to relative species like sheep and cattle.

The assessment of genetic variation and selection potential usually starts from separating the heritable component out of the observed variance or the heritability. The higher the heritability is, the more faithfully is the parents' superiority transmitted to the offspring. If the heritability is very low, then the genetic ranking of individuals would require resorting to relatives' information, as well. The Kutuharju data consisted of 1286 individuals. The genetic analysis was quite reliable, as the animals were offspring of altogether 71 sires. The heritability of daily gain was 32%. Such a high heritability says that selection on individual's own growth record would be effective and there is no need to set up a progeny test scheme.

In all mammals, the early survival and growth are strongly affected by dams. The best reindeer dams would every autumn bring a healthy good-sized calf to the round-up and would cherish the young one long over the first winter. The variation in maternal effects is partly due to genetic factors. In the Kutuharju data, the heritability of maternal effects was 22-24% (depending on the statistical model). This would raise questions like where to have the emphasis, on calf's own growth performance or on dam's maternal ability. There are limited metabolic resources which are during individual's development or later allocated to different parts and functions. In mammals, the genetic correlation between growth and maternal care are typically negative.

The Kutuharju data is very unique because due to the Norwegian investigations (Knut Røed) also sires of the individuals are known. Sire determination is based on molecular genetic typing. Hence it is possible to separate the individual own and maternal genetic component in the trait variation. There was a highly negative genetic correlation (-0.71 – -0.75) between growth and maternal ability in Kutuharju data. Therefore in reindeer, much attention should be paid to the selection of dam traits.

Conclusions:
- Kutuharju data is exhibiting lots of selection potential in the growth trait and with respect to selection, there is a substantial amount of variation between individuals
- Genetic variation in maternal effects could also be exploited in selection, thereby widening the possibilities of total selection potential
- Negative correlation between growth and maternal care could be circumvented by focussing on improving each other's efficiency without compromising in either of the traits
- Another lesson from the negative correlation is to pay attention to the management with maintaining even larger females in good condition.

Emien vaikutuksen arviointi Kutuharjun porojen painoista

Kirsi Muuttoranta[1], Mauri Nieminen[2] & Asko Mäki-Tanila[1]
[1]Maa- ja elintarviketalouden tutkimuskeskus, FI-31600 Jokioinen, [2]Riista- ja kalatalouden tutkimuslaitos, Porontutkimusasema, FI-99910 Kaamanen (Asko.Maki-Tanila@mtt.fi)

Porotalouden päätulo tulee teurasvasoista. Vasojen painoihin vaikuttavat monet tekijät, erityisesti vuosi ja lisäksi sukupuoli, syntymäaika ja laidunolot. Myös perinnöllisillä tekijöillä on vaikutusta syntymäpainoon ja kasvuun. Valinnan kannalta on kiinnostavaa selvittää, miten paljon kasvutaipumus on muutettavissa ja millä nopeudella sitä voidaan valinnalla muuttaa. Tutkittu aineisto on Paliskuntain yhdistyksen poroista Kutuharjun koetarhalta josta RKTL on kerännyt tiedot. Aineisto on hyvin uniikkia, koska se sisältää mm. tiedot syntymäpainoista. Vaihtelukerroin on käyttökelpoinen mittari verrattaessa eri kantoja tai lajeja toisiinsa. Vaihtelukertoimen avulla saadaan asteikosta riippumaton lukema vaihtelulle. Vasojen kasvun vaihtelukerroin oli 18% (uroksilla vähän pienempi kuin naarailla). Syntymäpainossa vaihtelu on samaa luokkaa (17%). Sukulaislajeihin verrattuna poron lihantuotannon muuttumisraami on laaja.

Perinnöllistä vaihtelua ja valinnan mahdollisuuksia tarkasteltaessa tarvitaan käsitys siitä kuinka suuri osa vaihtelusta johtuu perintötekijöistä (eli heritabiliteetti). Mitä suurempi heritabiliteetti on, sitä uskollisemmin vanhempien parempi kasvu näkyy jälkeläisissä. Jos periytymisaste on hyvin alhainen, valintaa varten tarvitaan silloin tietoja sukulaisilta. Kutuharjun aineistossa oli kasvutiedot 1286 eläimeltä. Periytymisasteen arvioinnin kannalta on oleellinen tieto, että nämä olivat yhteensä 71 isän jälkeläisiä. Tämän takia estimaattien keskivirheet pysyivät kohtuurajoissa. Päiväkasvun heritabiliteetiksi saatiin 32%. Kun periytymisaste on näin korkea, lihantuotannon parantamiseen tähtäävä valinta on tuloksellista jo yksilövalinnalla eikä tarvitse suunnitella jälkeläistestausta.

Kaikilla nisäkkäillä on emällä suuri vaikutus jälkeläisen alkukasvuun ja selviytymiseen. Parhaita ovat emät jotka tuovat säännöllisesti joka syksy erotukseen hyvävoimaisen ja kohtuukokoisen vasan ja huolehtivat menestyksellisesti vasasta vielä ensimmäisen talvenkin yli. Emien hoitokyvyn vaihtelu johtuu osaksi myös perintötekijöistä. Kutuharjun aineistossa kasvussa emävaikutuksen heritabiliteetti oli (mallista riippuen) 22-24%. Tästä herää heti kysymys – kumpaan valinnassa kannattaa enemmän kiinnittää huomiota vasan itsensä kasvutaipumuksen periytymisasteeseen vai emän hoitokyvyn periytymisasteeseen. Yksilöllä on rajalliset aineenvaihduntaresurssit, jotka yksilönkehityksen aikana ja aikuisiässä allokoituvat eri toiminnoille. Nisäkkäillä onkin tyypillisesti negatiivinen korrelaatio kasvun ja hoitokyvyn välillä.

Kutuharjun aineisto on hyvin ainutlaatuinen koska norjalaistutkimusten (Knut Røed) takia yksilöiltä tunnetaan isät. Isien määritys tehdään molekyyligeneettisesti. Näin kasvun vaihtelussa voidaan erottaa yksilön oma vaikutus ja lisäksi vanhemmista tarkastella omanaan emän vaikutusta. Kutuharjun poroilla kasvun ja hoitokyvyn geneettinen korrelaatio on negatiivinen ja melko suuri (-0.71:n ja -0.75:n välillä). Emän ominaisuuksien valintaan on porolla sen takia kiinnitettävä paljon huomiota.

Kutuharjun tuloksista voidaan vetää erilaisia johtopäätöksiä:
- Porojen kasvussa on paljon valinnalla hyödynnettävää muutospotentiaalia ja tehokkaan valinnan kannalta yksilöiden välillä huomattavasti perinnöllistä vaihtelua.
- Myös emien hoitokyvyssä olevaa perinnöllistä vaihtelua voidaan hyödyntää valinnassa ja näin nostaa muutosmahdollisuuksien kokonaissummaa.
- Kasvun ja hoitokyvyn välistä negatiivista korrelaatio voidaan kiertää keskittymällä kummankin ominaisuuden hyötysuhteen parantamiseen, tekemättä kummassakaan ominaisuudessa kompromisseja.
- Negatiivisen korrelaation yksi huomioimistapa on huolehtia hoitotyöllä siitä että suurikokoisetkin emät ovat aina hyvässä kunnossa.

Indicators for monitoring changes in grazing resources

Anna Olofsson[1], Öje Danell[1], Pär Forslund[2], & Birgitta Åhman[1]
[1]Swedish University of Agricultural Sciences, Department of Animal Nutrition and Management, P.O. Box 7024, S-75007 Uppsala, Sweden (anna.olofsson@rene.slu.se).
[2]Swedish University of Agricultural Sciences, Ecology Department, P.O. Box 7002, S-75007 Uppsala, Sweden.

Since grazing resources is a main limiting factor for reindeer husbandry, early detection of changes in these resources are particularly crucial. We investigated two possible indicators of changes in grazing resources, one for winter ranges and one for ranges used during the snow-free period. Our intention was that the indicators should be simple and time-effective to easily be incorporated in the practical management of grazing resources within a herding district.

The chosen indicator of change in winter pastures focuses on changes in the lichen resources. In a core lichen area, where grazing is homogenously distributed within the area, regularly distributed lichen height measurements could be used for detecting changes in lichen biomass and cover (cover indirectly measured by the frequency of measurement points with lichen). We found significant effects of forest age and density on lichen height as well as of forest age on lichen cover, and thus these are important factors to take in account. The number of measurement points needed for detecting a change of 5 mm with power 0.95 ranged from 200 to 2000 depending on lichen height variation within the area. A minimum distance of 4 m between measured points was found recommendable to avoid spatially autocorrelated data. Since the moisture level of lichen was found to affect the height measures in irregular ways, we recommend that the measurements should consistently be made under similar weather conditions.

The indicator chosen for detection of changes of range conditions during the snow-free period were carcass measures (weight and fat and conformation scores) from commercial autumn slaughter. Using the slaughter records from 1994-2007 (~430 000 observations) we detected long-term trends, which are positively correlated between calves, females and males. We also estimated within-season trends for carcass measures; generally females gained in body resources from October until December while calves lost body resources. Males showed no clear trend in carcass measures during the investigated time period (September). Moreover, we found effects of population density on female and calf, but not male carcass measures. Some problems with the classification of animals were identified; non-consistent selection of slaughter animals in combination with the current wide classes, and uncertainties in the classification of calves versus yearlings, which both might easily cause biases in estimated changes. We suggest improvements in terms of more detailed age and sex classifications of carcasses and, based on a separate investigation, we suggest adding of a body size measure the commercial carcass measures if slaughter records are to be used for monitoring of changes in grazing conditions.

Indikatorer för mätning av förändringar i betesresurserna

Anna Olofsson[1], Öje Danell[1], Pär Forslund[2] & Birgitta Åhman[1]
[1]Sveriges Lantbruksuniversitet (SLU), Institutionen för husdjurens utfodring och vård, Box 7024, 75007 Uppsala, Sverige (anna.olofsson@huv.slu.se). [2]SLU, Institutionen för Ekologi, Box 7002, 75007 Uppsala.

Eftersom betestillgång är en viktig begränsande faktor i renskötseln är det vitalt att tidigt upptäcka förändringar i betesresurserna. Vi har undersökt två möjliga indikatorer på förändringar i renbetesresurserna, en för vinterförhållanden och en för den snöfria perioden. Vår intention var att dessa indikatorer skulle vara okomplicerade och tidssnåla för att lätt införlivas i praktisk förvaltning av betesresurserna i en sameby.

Indikatorn vi valde för vinterbetesförhållandena fokuserar på förändringar i lavresursen. I ett kärnområde av lavmarker, där betestrycket är homogent fördelat över området, kan lavhöjdsmätningar jämt fördelade över området användas för att upptäcka förändringar i lavbiomassa och täckningsgrad (det senare genom frekvensen av mätpunkter med lav). Våra resultat visade att både skogens ålder och täthet påverkar lavhöjden och att skogens ålder även påverkar lavens täckningsgrad. Eftersom detta är faktorer som förändras över tid är de viktiga att ta hänsyn till. Antalet mätpunkter som behövs för att upptäcka en förändring på 0,5 mm med 95% säkerhet varierade mellan 200 och 2000 beroende på lavhöjdens variation i områdena. Utifrån våra resultat rekommenderar vi en minsta distans på 4 m mellan mätpunkterna för att undvika rumsligt autokorrelerade data. Eftersom lavens fuktighetsgrad påverkar lavhöjden och effekten troligtvis varierar beroende på lavens täthet, så rekommenderar vi att lavhöjdsmätningar alltid görs vid samma typ av väderlek.

Den valda indikatorn på förändringar i betesresursen under den snöfria perioden var slaktkroppsdata (vikt, samt fett- och formklassifikation) från kommersiell höstslakt. I slaktdata från 1994-2007 (~430 000 observationer) kunde vi upptäcka långsamma trender som var positivt korrelerade mellan kalvar, vajor och handjur (sarvar och oxar). Vi kunde också skatta trender inom slaktsäsongen, generellt ökade vajor sina kroppsreserver under perioden oktober till december, menad kalvar tappade kroppsreserver under denna period. Hos handjuren fann vi inga entydiga under den period som undersöktes (september). Vi hittade även effekt av populationstäthet på kalvars och vajors kondition, men inte på handjurens kondition. Vi identifierade ett par problem med klassificeringen av djur, de få och vida djurkategorierna i nuvarande datamaterial i kombination med eventuell inkonsekvent selektion av slaktdjur, samt den osäkerhet som finns i åtskiljandet av kalvar och åringar. Dessa båda faktorer kan båda orsaka felaktiga skattningar av förändringar. Vi föreslår en förbättring i form av snävare köns- och åldersklasser i slaktdata och, baserat på en annan studie, föreslår vi även användande av ett kroppsstorleksmått om slaktdata skall användas för att indikera förändringar i betessituationen.

Sami TEK as a guide to climate change science: Impacts of snow, ice and reindeer pasture

Jan Åge Riseth[1], Hans Tømmervik[2], Elina Helander-Renvall[3], Niklas Labba[4], Cecilia Johansson[5], Eirik Malnes[6], Jarle W. Bjerke[7], Christer Jonasson[8], Veijo Pohjola[9], Lars-Erik Sarri[10], Audhild Schanche[11], & Terry V. Callaghan[12]

[1]Norut Northern Research Institute Tromsø & Sami University College, P.O. Box 250, N-8504 Narvik, Norway (janar@norut.no); [2]Norwegian Institute for Nature Research, N-9296 Tromsø, Norway (hans.tommervik@nina.no); [3]Arctic Indigenous Peoples and Sami Research Office, Arctic Centre, University of Lapland, FIN-96101 Rovaniemi, Finland (elina.helander-renvall@ulapland.fi); [4]Moskavuona Sami Language and Culture Centre, N-9042 Laksvatn, Norway (n.labba@gmail.com); [5]Department of Earth Sciences, Uppsala University, S-75236 Uppsala, Sweden (Cecilia.Johansson@met.uu.se); [6]Norut Northern Research Institute, N-9294 Tromsø, Norway (eirik.malnes@norut.no); [7]Norwegian Institute for Nature Research, N-9296 Tromsø, Norway (jarle.werner.bjerke@nina.no); [8]Abisko Scientific Research Station, S-98107 Abisko, Sweden (christer.jonasson@ans.kiruna.se); [9]Department of Earth Sciences, Uppsala University, S-75236 Uppsala, Sweden (veijo.pohjola@geo.uu.se); [10]Esrange, Swedish Space Corporation, S-98128 Kiruna, Sweden (larserik.sarri@esrange.ssc.se); [11]Sami Parliament, N-9730 Karasjok, Norway (audhild.schanche@samediggi.no); [12]Abisko Scientific Research Station, S-98 107 Abisko, Sweden; Department of Animal and Plant Sciences, University of Sheffield, S10 2TN, UK (terry_ callaghan@btinternet.com).

Scientific studies of climate change challenges could be improved by including other sources of knowledge, such as traditional ecological knowledge (TEK). This study focuses on: local variations in snow and ice conditions, effects of the first durable snow, and long-term changes in snow and ice-conditions as pre-requisites for understanding potential future changes.

Firstly, we characterised snow types and profiles based on Sami categories and measured their density and hardness. Regression analysis showed that density can explain much of the variation in hardness, while snow depth was not significantly correlated with hardness. Secondly, we found that whether it is dry/cold or warm/wet around the fall of the first durable snow is, according to Sami reindeer herders, crucial information for forecasting winter grazing conditions, but this has had limited focus within science. Thirdly, elderly herders' observations of changes in snow and ice conditions by "reading nature" can aid reinterpretation of meteorological data by introducing researchers to alternative perspectives.

Conclusively we found remarkable agreement between scientific measurements and Sami terminology. We also learnt that TEK/science-cooperation has much potential for climate change studies, though time and resources are needed to bridge the gap between knowledge systems. In particular, TEK attention to shifts in nature can be a useful guide for science.

Samisk tradisjonskunnskap som veiviser for forskning på klimaendringer: Virkninger for snø, is og reinbeiter.

Vitenskaplige studier av utfordringene ved klimaendringer kan bli forbedret ved å inkludere andre kunnskapskilder, som tradisjonskunnskap. Denne studien fokuserer på: lokale variasjoner i snø og is-forhold, effekter av den første varige snøen og langtidsendringer i snø- og isforhold som grunnlag for å forstå mulige framtidige endringer.

For det første klassifiserte vi snøtyper og -profiler basert på samiske kategorier og målte tetthet og hardhet. Regresjonsanalyse viste at tetthet kan forklare mye av variasjonen i hardhet, mens snødybde ikke var signifikant korrelert ned hardhet. For det andre fant vi at hvorvidt det var tørt og kaldt eller varmt og vått når den første varige snøen kommer er, i følge reindriftssamer, kritisk informasjon for å forutsi vinterens beiteforhold, men dette har hatt liten forskningsmessig oppmerksomhet. For det tredje kan eldre reindriftssamers observasjoner av endringer gjennom å "lese naturen" støtte nytolkning av meteorologiske data ved å introdusere forskere for alternative perspektiver.

Vi konkluderte med å finne påfallende sammenfall mellom vitenskapelige malinger og samisk terminologi. Vi kom også fram til at samarbeid mellom tradisjonskunnskap og vitenskap har stort potensial i studier av klimaendring. Særlig kan tradisjonskunnskapens oppmerksomhet mot endringer i naturen bli en verdifull guide for vitenskapen.

Rumen metanogens and methane emissions from reindeer

Monica A. Sundset[1], Kia Krarup Hansen[1], Lars P. Folkow[1], & Svein D. Mathiesen[2]
[1]Department of Arctic and Marine Biology, Faculty of Biosciences, Fisheries and Economics, University of Tromsø, Tromsø, Norway (monica.a.sundset@uit.no).
[2]Sami University College, Kautokeino, Norway; International Centre for Reindeer Husbandry, Kautokeino, Norway; Norwegian School of Veterinary Science, Sjøgata 39, Tromsø, Norway.

The increased concentration of atmospheric methane has been identified as a major contributor to global warming. The potent greenhouse gas methane (CH_4) is emitted from a variety of natural sources (e.g. wetlands, gas hydrates, permafrost, termites and wildfires) and human-related (anthropogenic) sources (e.g. fossil fuel production, rice cultivation, biomass burning, waste management and animal husbandry). Up to 12% of the energy intake in domestic ruminants is lost in the form of methane produced by methanogenic archaea in their rumen and hindgut. Hence, enteric methane emissions from ruminants represent not only a source of this greenhouse gas but also a loss of energy to the individual animal. World ruminant numbers are increasing and ruminants currently account for ~16% of the global methane emissions and ~26% of the anthropogenic methane production. Domesticated livestock are the most common ruminants and include 1.5 billion cattle and 1 billion sheep, while reindeer comprise only ~5 million animals divided among 7 extant subspecies in the Northern Hemisphere. The reindeer rumen represents a complex symbiotic microbial ecosystem of methanogenic archaea, anaerobic bacteria, ciliates and anaerobic fungi evolved through a long history of feeding on Arctic plants and lichens (Mackie et al., 2003 Appl Environ Microbiol 69:6808-6815; Sundset et al., 2007 Microb Ecol 54:424-438). Rumen methanogens use electrons derived from H_2 to reduce CO_2 to CH_4. Accumulation of H_2 as a waste product of rumen microbial fermentation inhibits the metabolism, and so the removal of hydrogen by methanogens is important to maintain normal rumen functioning. Cultivation-based studied of rumen methanogens in Svalbard reindeer (*Rangifer tarandus platyrhynchus*) indicated very low population densities (10^4-10^7 cells/ml rumen fluid) (Orpin et al., 1985 Appl Environ Microbiol 50:144-151) compared to those found in domestic ruminants (10^9 cells/ml rumen fluid) (Skillman et al., 2004 Anaerobe 10:277-285). Dominant rumen methanogens in both Svalbard and Norwegian reindeer (*R. t. tarandus*) were later identified using a 16S rRNA gene library approach (Sundset et al., 2009 FEMS Microbiol Ecol 70:553-562; Sundset et al., 2009 Microbiol Ecol 57:335-348), and our data so far indicate that there is a small variation in the diversity of rumen methanogens between reindeer and other geographically and / or genetically distant ruminants. However, numbers of rumen methanogens generated using primers targeting the mcrA gene (only found in methanogenic archaea) are comparable in Svalbard and Norwegian reindeer but lower than those found in domestic ruminants such as sheep and cattle. Mean densities of rumen methanogenic archaea in Norwegian reindeer (n=5) grazing in natural summer pasture and Svalbard reindeer (n=5) on late fall pasture (October) are 3.02×10^8 and 4.01×10^8 cells/g wet weight, respectively. In winter, mean numbers of rumen methanogens drop as low as 5.16×10^7 in Svalbard reindeer (n=5). Studies of domestic ruminants indicate a direct correlation between levels of methane emission and ruminal numbers of methanogens. Hence, the low numbers of rumen methanogens found in reindeer suggest that reindeer may emit less methane compared to other domestic ruminants, so that the energy instead can be used in favour of growth and survival in these arctic ruminants.

We expect an even greater focus on production and emission of greenhouse gases such as methane in the future. In fact, greenhouse gas emissions are currently used as an argument to reduce the number of reindeer in Norway. An important objective of this study is consequently to quantify the emissions of methane and the energy this entails for the reindeer at different times of the year and on different diets.

Metanogener i reinens vom og utslipp av metan fra rein

Monica A. Sundset[1], Kia Krarup Hansen[1], Lars P. Folkow[1] & Svein D. Mathiesen[2]
[1]Institutt for Arktisk og Marin Biologi, Fakultetet for Biovitenskap, Fiskeri og Økonomi, Universitetet i Tromsø, Tromsø, Norge (monica.a.sundset@uit.no).
[2]Samisk Høgskole, Kautokeino, Norge; International Centre for Reindeer Husbandry, Kautokeino, Norge; Norges Veterinærhøgskole, Sjøgata 39, Tromsø, Norge.

Den økte konsentrasjonen av atmosfærisk metan er identifisert som den nest største bidragsyteren til global oppvarming. Den potente klimagassen metan (CH_4) slippes ut fra en rekke naturlige kilder (f.eks våtmarker, gasshydrater, permafrost, termitter og skogbranner) og menneskerelaterte (antropogene) kilder (f.eks fossilt brensel produksjon, ris dyrking, brenning av biomasse, søppel og husdyrhold). Opp til 12% av energiinntaket hos tamme drøvtyggere går tapt i form av metan som produseres av mikroorganismer kalt metanogener i vom og baktarm. Enteriske utslipp av metan fra drøvtyggere representerer derfor ikke bare en kilde til denne klimagassen, men også et tap av energi for det enkelte dyr. Antall drøvtygger i verden er økende og drøvtyggere står i dag for ~ 16 % av de globale metanutslippene og ~ 26% av den antropogene metanproduksjonen. Tamme husdyr er de vanligste drøvtyggerne og inkluderer 1,5 milliarder storfe og 1 milliard sauer, mens rein bare utgjør ca 5 millioner dyr fordelt på 7 underarter på den nordlige halvkule. Reinvomma representerer et kompleks symbiotisk mikrobielt økosystem av metanogener, anaerobe bakterier, ciliater og anaerob sopp utviklet gjennom millioner av år på en diett av arktiske planter og lav (Mackie et al., 2003 Appl Environ Microbiol 69:6808-6815; Sundset et al., 2007 Microb Ecol 54:424-438). Vommetanogener bruker elektroner fra H_2 til å redusere CO_2 til CH_4. Akkumulering av H_2 som er et avfallsprodukt fra den mikrobielle gjæringa i vomma hemmer metabolismen, og metanogenenes fjerning av H_2 er derfor viktig for å opprettholde den normale vomfunksjonen. Dyrkningstudier av metanogener fra vomma til Svalbardrein (*Rangifer tarandus platyrhynchus*) indikerte svært lave konsentrasjoner av disse mikroorganismene (10^4-10^7 celler / ml vomma) (Orpin et al., 1985 Appl Environ Microbiol 50:144-151) sammenlignet med det som finnes i tamme drøvtyggere som ku og sau (10^9 celler / ml vomma) (Skillman et al., 2004 Anaerobe 10:277-285). Dominante metanogener i vomma til både Svalbardrein og norsk rein (*R. t. tarandus*) ble senere identifisert ved hjelp av 16S rRNA gen bibliotek (Sundset et al., 2009 FEMS Microbiol Ecol 70:553-562; Sundset et al., 2009 Microbiol Ecol 57: 335-348), og våre data tyder på at det er en liten variasjon i mangfoldet av vom-metanogener mellom rein og andre geografisk og / eller genetisk fjerne drøvtyggere. Antall vom-metanogener bestemt ved bruk av primere rettet mot mcrA genet (som bare finnes i metanogener) er imidlertid sammenlignbare hos Svalbardrein og norsk rein, men lavere enn hos sau og storfe. Gjennomsnittlig tetthet av vom-metanogener hos norsk rein (n=5) på naturlig sommer beite og Svalbardrein (n=5) på høstbeite (oktober) er henholdsvis $3{,}02 \times 10^8$ og $4{,}01 \times 10^8$ celler/g. Om vinteren, er antall vom-metanogener hos Svalbardrein (n=5) falt helt ned til $5{,}15 \times 10^7$. Studier av tamme drøvtyggere indikerer en direkte sammenheng mellom nivået av metan utslipp og antall metanogener i vom. Det lave antall vom-metanogener funnet i rein tyder derfor på at reinen trolig slipper ut mindre metan enn andre tamme drøvtyggere, slik at energien i stedet kan brukes til fordel for vekst og overlevelse i disse arktiske drøvtyggere.

Vi forventer et enda større fokus på produksjon og utslipp av klimagasser som metan i fremtiden. Faktisk brukes utslippene av klimagasser i dag som et argument for å redusere antallet rein i Norge. En viktig målsetning med dette studiet er derfor å kvantifisere utslippene av metan fra rein og energitapet dette medfører til ulike tider av året og på ulike dietter.

Vegetation Changes in Reindeer Winter Corrals in Finnish Lapland

Minna Turunen[1], Oksanen, P.[1], Markkula, I.[1], Vuojala-Magga, T.[1,2], Sutinen, M.-L.[3] Maijala, J.[4], & Tuomaala, R.[5]

[1]Arctic Centre, University of Lapland, POB 122, FI-96101 Rovaniemi, Finland (minna.turunen@ulapland.fi). [2]Herding Co-operative Hammastunturi, Kuttura, Finland. [3]METLA, Rovaniemen Research Unit, Rovaniemi, Finland. [4]Herding Co-operative Oraniemi, Sodankylä, Finland. [5]Herding Co-operative Kuukas, Ranua, Finland.

Supplementary feeding of reindeer started to become common in southern part of the reindeer herding area in Finland in the end of the 1960s. It has gradually spread from the south towards the north. Due to reduced and deteriorated winter pastures, nowadays only a small proportion of reindeer overwinters on natural pastures without supplementary feeding. In recent years, the availability of winter forage has been reduced also due to changing climate. Compaction of snowpack, ice layers and/or exceptionally thick snowcover have deteriorated the digging conditions of reindeer. Supplementary feeding secures the survival of reindeer during extreme winters, it facilitates herding work, and keeps the number and condition of reindeer stable. In reindeer herding area of Finland, supplementary feeding of reindeer has been carried out by using two main practices: by feeding reindeer with fodder on the natural winter pasture, or by keeping reindeer at the corral during the winter time.

The aim of this research is to study the coverage of species (ground and field layer) of the reindeer winter corrals in three reindeer herding co-operatives (Hammastunturi, Oraniemi, Kuukas) in Finnish Lapland. In these corrals, each varying in size (100 m^2 – 100 ha), reindeer have been fed by supplementary forage (e.g. silage, pellets) for several winters. Species coverage of higher plants, lichens and mosses were determined quantitatively at different distances inside and outside the fence.

Species composition of both ground and field layer within the studied corrals has been significantly changed when compared to the control area located outside the corral. The corrals that were established on the sub-xeric pine heath were characterized by reduced coverage of shrubs, including crowberry (*Empetrum nigrum*), cowberry (*Vaccinium vitis-idaea*) and bilberry (*V. myrtillus*). The coverage of naturally growing wavy hair-grass (*Deschampsia flexuosa*) had increased. In addition to graminoids (e.g. *Poa pratensis*) derived from the supplementary forage (hay), also nitrogen favouring species, such as Rosebay willowherb (*Epilobium angustifolium*) and weed plants, such as chickweed (*Stellaria media*) had appeared into the corral. Another reindeer winter corral, established on dwarf shrub pine bog, was characterized by reduced coverage of cotton grass (*Eriophorum vaginatum*), bog bilberry (*V. uliginosum*) and cloudberry (*Rubus chamaemorus*). These species were partly replaced by graminoids (*D. flexuosa*, *D. cespitosa*, *P. pratensis*) and sedges (*Carex lapponica*, *C. magellanica*). Also *E. angustifolium* and *S. media* had appeared into the corral.

Porojen ruokinta-aitausten kasvillisuusmuutokset Suomen Lapissa

Minna Turunen[1], Oksanen, P.[1], Markkula, I.[1], Vuojala-Magga, T.[1,2], Sutinen, M.-L.[3] Maijala, J.[4], & Tuomaala, R.[5]

[1]Arktinen keskus, Lapin yliopisto, PL 122, 96101 Rovaniemi, Finland (minna.turunen@ulapland.fi). [2] Hammastunturin paliskunta, Kuttura, Finland. [3]Metsäntutkimuslaitos, Rovaniemen tutkimusyksikkö, Rovaniemi, Finland. [4]Oraniemen paliskunta, Sodankylä, Finland. [5]Kuukaan paliskunta, Ranua, Finland.

Porojen lisäruokinta alkoi Suomessa yleistyä 1960-luvun lopulla eteläisellä poronhoitoalueella, mistä se on vähitellen yleistynyt pohjoista kohti. Talviset luonnonlaitumet ovat vähentyneet ja niiden kunto on heikentynyt. Tämän vuoksi nykyisin vain pieni osa poroista laiduntaa talven ajan pelkästään luonnonravinnon varassa. Viime vuosina poron talviravinnon saatavuus on heikentynyt myös muuttuvan ilmaston vuoksi. Kovettuneet hanget, jääkuoret ja/tai poikkeuksellisen paksu lumipeite ovat vaikeuttaneet porojen kaivuuolosuhteita. Lisäruokinnalla pyritään turvaamaan porojen selviytyminen poikkeuksellisina talvina, helpottamaan porojen paimentamista sekä pitämään porojen lukumäärä ja kunto vakaana. Suomen poronhoitoalueella porojen ruokinta on toteutettu pääasiassa kahdella tavalla: viemällä poroille lisäravintoa (mm. säilöheinä, pelletit) maastoon tai pitämällä poroja talvisin tarhoissa tai aitauksissa.

Tämän tutkimuksen tavoitteena on selvittää kasvipeitteen lajikoostumus (pohja- ja kenttäkerros) useamman vuoden käytössä olleissa porotarhoissa ja -aitauksissa kolmen paliskunnan (Kuukas, Oraniemi, Hammastunturi,) alueella Suomen Lapissa. Näissä kooltaan vaihtelevissa aitauksissa ($100m^2$ – 100ha), poroja on ruokittu (mm. säilörehu, pelletit) säännöllisesti usean talven ajan. Putkilokasvi-, jäkälä- ja sammallajien peittävyydet määritettiin kvantitatiivisesti eri etäisyyksien päässä aidan sisä- ja ulkopuolella.

Tutkituissa porotarhoissa ja -aitauksissa pohja- ja kenttäkerroksen lajikoostumus oli muuttunut voimakkaasti verrattuna aidan ulkopuolella sijaitsevaan kontrollialueeseen. Kuivahkolle mänty-kankaalle perustetuissa aitauksissa varpujen, kuten variksenmarjan (*Empetrum nigrum*), puolukan (*Vaccinium vitis-idaea*) ja mustikan (*V. myrtillus*) peittävyys oli alentunut. Luontaisesti alueella kasvavan metsälauhan (*Deschampsia flexuosa*) peittävyys oli lisääntynyt. Rehusta peräisin olevien heinien (mm. *Poa pratensis*) lisäksi myös typen suosijoita, kuten maitohorsmaa (*Epilobium angustifolium*) ja rikkakasveja, kuten pihatähtimöä (*Stellaria media*) oli ilmestynyt aidan sisäpuolelle. Isovarpurämeelle perustetun porotarhan kasvillisuuskartoitus osoitti, että monien suokasvien, kuten tupasvillan (*Eriophorum vaginatum*), juolukan (*V. uliginosum*) ja hillan (*Rubus chamaemorus*) peittävyydet olivat alentuneet. Nämä lajit olivat osittain korvautuneet heinillä (D. flexuosa, *D. cespitosa*, *P. pratensis*) ja saroilla (*Carex lapponica*, *C. magellanica*). Myös *E. angustifolium* ja *S. media* olivat ilmaantuneet suolle perustettuun porotarhaan.

Reindeer avoid eating ergot fungus

Pauliina P. Wäli[1], Piippa R. Wäli[1], Mauri Nieminen[2], & Juha Tuomi[1]
[1]University of Oulu, Department of Biology, P.O. Box 3000, FI-90014 University of Oulu (pauliina.wali@oulu.fi); [2]Finnish Game and Fisheries Research Institute, Reindeer Research Station, Toivoniementie 246, FI-99910 Kaamanen.

Ergot (*Claviceps purpurea*) is a fungal seed pathogen of grasses. Ergot infects its host when flowering and the dark colored fungal structure, sclerotium, replaces one or few of the grass seeds. Ergot is common on cereals and forage grasses as well as in natural grass populations all over Scandinavia.

Ergot sclerotia contain alkaloids (ergot alkaloids) toxic to mammals. Sclerotia are mechanically separated from grain products, but in addition to grain also pasture and forage grasses are potential sources of ergot. Symptoms similar to ergot poisoning have recently been reported from wild moose and roe deer in Finland and Norway, and at least in part of the cases the symptoms are suspected to result from ingestion of wild ergot.

In this study we explored whether reindeer avoid eating ergot-containing food. In a food choice test reindeer were let to select between pure (control) and ergot sclerotia containing forage pellets. Reindeer had the possibility to visually examine, smell and touch/taste the feeds, but the test was interrupted after eating decision was made.

In the experimental setting reindeer clearly avoided or learned to avoid eating ergot-containing forage when given a choice. The results imply that reindeer are able to avoid eating ergot also when grazing.

Porot välttävät torajyvän syömistä

Pauliina P. Wäli[1], Piippa R. Wäli[1], Mauri Nieminen[2] & Juha Tuomi[1]
[1]Oulun yliopisto, Biologian laitos, PL 3000, 90014 Oulun yliopisto (pauliina.wali@oulu.fi); [2]Riista- ja kalatalouden tutkimuslaitos, Porontutkimusasema, Toivoniementie 246, 99910 Kaamanen.

Torajyvä (*Claviceps purpurea*) on heinäkasveilla esiintyvä loissieni. Torajyvä tartuttaa isäntäheinän sen kukkiessa, minkä seurauksena sienen tumma, siementä suurempi rihmastopahka korvaa yhden tai useamman kehittyvistä siemenistä. Torajyvää esiintyy yleisenä viljoilla sekä rehu- ja luonnonheinillä koko Skandinaviassa.

Torajyvän rihmastopahkat tuottavat myrkyllisiä alkaloideja (ergotalkaloideja), jotka voivat nautittuna aiheuttaa nisäkkäille myrkytysoireita. Torajyvää seulotaan pois viljatuotteista, mutta myös laidun- ja rehuheinä ovat mahdollisia torajyvän lähteitä. Torajyvämyrkytyksiä on raportoitu viime aikoina hirvieläimiltä Suomesta ja Norjasta, ja ainakin osan tapauksista on arveltu johtuneen luonnonheinissä esiintyvästä torajyvästä.

Tässä tutkimuksessa testasimme välttävätkö porot ravinnon joukossa olevan torajyvän syömistä. Koetilanteessa porojen annettiin valita puhtaan rehun ja torajyvää sisältävän rehun välillä; poroilla oli mahdollisuus haistella ja tunnustella/maistaa rehua, mutta syömispäätöksen jälkeen koetilanne keskeytettiin. Tulosten perusteella porot välttävät tai oppivat nopeasti välttämään torajyvällisen rehun syömistä. Tämä antaa viitettä siitä, että porot pystynevät välttämään torajyvän syömistä myös heinäkasveja laiduntaessaan.

Renlycka - a Sami quality trademark for reindeer meat

Eva Wiklund, Ol-Johán Sikku, & Anders Blom
Svenska Samernas Riksförbund/National Union of the Swedish Sami People, Magasinsgatan 7, 903 27 Umeå, Sweden (eva@sapmi.se).

This quality trade mark highlights the connection between the Sami culture, the reindeer as an animal and the meat as a product. Since ancient times reindeer husbandry has developed hand in hand with the environment, based on traditional knowledge about the relationships between reindeer, nature, humans and culture. The quality trade mark Renlycka guarantee products of highest quality all the way along the chain from the management of the living reindeer by knowledgeable reindeer herders to the production of excellent meat products by the Sami meat processors. This association is important when considering the profile of the products as hand-made, natural and traditional with strong ethnic links to the Sami People.

Renlycka quality trade mark is based on the following values:

Pure taste experience
The exceptional flavour and tenderness of reindeer meat originates from the natural pasture, *i.e.* a mixture of protein rich herbs, grasses and mushrooms during the summer and energy rich lichens on the winter pasture. The processing of the meat is based on traditional recipes from thousands of years of experience and now developed to products for today's consumers.

Sami origin
This quality trade mark highlights the connection between the Sami culture, the reindeer as an animal and the meat as a product. Since ancient times reindeer husbandry has developed hand in hand with the environment, based on traditional knowledge about the relationships between reindeer, nature, humans and culture. Renlycka is a traditional concept that describes the close connection between Sami culture and the unique and genuine knowledge of the reindeer herder.

Quality
The quality trade mark Renlycka guarantee products of highest quality all the way along the chain from the management of the living reindeer by knowledgeable reindeer herders to the production of excellent meat products by the Sami meat processors. The Sami meat processors that qualify for the quality trade mark will guarantee that the meat comes from reindeer that have been grazing natural pasture in the reindeer herding districts on the Swedish side of Sápmi and that the products are processed according to the quality standards of Renlycka.

Care about animals and the environment
The traditional knowledge of a reindeer herder is a special competence in animal husbandry carried out in harsh Arctic climate conditions, in addition the biodiversity in vegetation and water as well as important cultural aspects also have to be considered. Good environmental conditions are essential for a sustainable production of high quality reindeer meat.

Renlycka – ett samiskt kvalitetssigill för renkött

Eva Wiklund, Ol-Johán Sikku & Anders Blom
Svenska Samernas Riksförbund, Magasinsgatan 7, 903 27 Umeå, Sverige. E-mail: eva@sapmi.se

Kvalitetssigillet tydliggör den samiska kulturens samhörighet med renen och renköttet. Sedan urminnes tid har renskötseln utvecklats hand i hand med naturen utifrån traditionell kunskap om Renens förhållande till natur, människa och kultur. Kvalitetssigillet Renlycka borgar för att ren-produkterna håller hög kvalitet, från den levande renens skötsel av kunniga renskötare i ett unikt skötselsystem, till förädling av köttet via de samiska förädlingsföretagen. Detta är viktigt med tanke på produktens profil som hantverksmässigt naturproducerad med djupa traditioner och med den etniska kopplingen till naturfolket samerna.

Kvalitetssigillet Renlycka bygger på följande värden:

Ren smakupplevelse
Renköttet får den goda smaken och mörheten från renens naturliga bete av bl.a. proteinrika örter, gräs och svamp under sommarhalvåret och energirikt lavbete under vinterhalvåret. Förädlingen av köttet kommer från flertusenåriga traditioner som har utvecklats till produkter för dagens konsumenter.

Samiskt ursprung
Kvalitetssigillet tydliggör den samiska kulturens samhörighet med renen och renköttet. Sedan urminnes tid har renskötseln utvecklats hand i hand med naturen utifrån traditionell kunskap om renens förhållande till natur, människa och kultur. Renlycka är ett traditionellt begrepp som är knutet till den samiska kulturen och den genuina kunskap som renskötaren har i samspel med naturen.

Kvalitet
Renlycka borgar för att renprodukterna håller hög kvalitet, från den levande renens skötsel av kunniga renskötare i ett unikt skötselsystem, till förädling av köttet via de samiska förädlingsföretagen. Ett Renlycka-godkänt förädlingsföretag garanterar att råvaror till Renlycka-godkända produkter kommer från renar som gått på naturbete från samebyarna på svensk sida av Sápmi och förädlas enligt de kvalitetskrav Renlycka ställer.

Omsorg om djur och natur
Renskötarens traditionella kunskap är ett specialkunnande om god djurvård i ett kargt arktiskt klimat, samtidigt som både den biologiska mångfalden i mark och vatten samt viktiga kulturvärden värnas. Den rena naturmiljön är en förutsättning för en långsiktig produktion av renkött av högsta kvalitet.

Microbiological shelf life of fresh, chilled reindeer meat (*M. longissimus*)

Eva Wiklund[1], Anneli Jonsson[2], & Lennart Blindh[3]
[1]National Union of the Swedish Sami People, Magasinsgatan 7, 903, 27 Umeå, Sweden, [2]Idre Ren AB, Kantatvägen 12, 131 40 Nacka, Sweden, [3]Blindh Ren AB, Ängsvägen 12, 840 95 Funäsdalen, Sweden (eva@sapmi.se).

Background
The shelf life of fresh meat is often evaluated on the basis of microbiological quality, *i.e.* the total amount and type of bacteria growing on the meat. The limit for an acceptable microbiological quality is set to log 7 CFU (Colony Forming Units)/g aerobic bacteria. If the total amount of aerobic bacteria is over that limit the meat is considered to be of poor microbiological quality. In this pilot study we have examined the shelf life of chilled vacuum packaged reindeer meat stored at +4 °C.

Material and methods
Six reindeer calves (age 4 months) were included in the study. The reindeer were slaughtered according to standard procedure at Lossen reindeer slaughter plant in Härjedalen, Sweden. At boning, the pH values were measured in the striploin (*M. longissimus*) at the last rib. These measurements were taken to guarantee that the six calves selected for further sampling all would have an ultimate pH value below 5.8 in the loin. The left side loins from the six calves were divided in five pieces that were randomly assigned to five different storage times; sampling directly after packaging and after chilled storage for 2, 3, 4 and 5 weeks at +4 °C. All pieces were vacuum packaged and labelled clearly. The samples were then transported chilled to Hjortens Laboratory in Östersund where the storage, microbiological sampling and analysis took place. Microbiological analyses of total amount of aerobic bacteria and e-coli bacteria were carried out according to standard methods.

Results and discussion
The total amount of bacteria at the first sampling directly after packaging was low (log 2,1 CFU/g), but then rapidly increased. After two and three weeks chilled storage the microbiological quality of the samples were on the border-line to poor (log 6,7 CFU/g and log 6,8 CFU/g, respectively). At four and five weeks of chilled storage the limit for acceptable quality of log 7 CFU/g aerobic bacteria had been passed. Therefore, the storage time for fresh reindeer meat should not exceed 3 weeks at a temperature of +4 °C.
Reindeer meat is mostly sold as a frozen product although several slaughter plants indicate that there is a slow increase in the demand for fresh meat. There is a need for new knowledge around issues concerning the handling, packaging and storage of reindeer meat. Factors that have been identified as very important for the shelf life of fresh meat are pH value, slaughter hygiene and chilling temperature. Most of this knowledge originates from studies carried out on other meat types, and even if many of the basic principles around meat are similar, there is still a need for further studies of mainly he effects of chilling temperature and packaging material on the shelf life of fresh chilled reindeer meat.

Conclusions
The companies that today sell fresh vacuum packaged reindeer meat will guarantee a shelf life of 21 days (three weeks). That agrees well with the results from the present pilot study where we could conclude that the storage time for fresh reindeer meat should not exceed three weeks at +4 °C. Previous studies on other meat types have demonstrated that a variation in storage temperature has a significant impact on the shelf life of the meat, *i.e.* a guaranteed shelf life of 21 days at +4 °C can be dramatically reduced or increased if the temperature changes by ±2 °C.

Mikrobiologisk kvalitet hos färskt kyllagrat renkött (*M. longissimus*)

Eva Wiklund[1], Anneli Jonsson[2] & Lennart Blindh[3]
[1]Svenska Samernas Riksförbund, Magasinsgatan 7, 903, 27 Umeå, Sverige, [2]Idre Ren AB, Kantatvägen 12, 131 40 Nacka, Sverige, [3]Blindh Ren AB, Ängsvägen 12, 840 95 Funäsdalen, Sverige (eva@sapmi.se).

Bakgrund
Hållbarhet hos färskt kött anges ofta baserat på mikrobiologisk kvalitet, *d.v.s.* totalantal och typ av bakterier som växer på köttet. Gränsvärdet för att avgöra om köttet bedöms ha en bra mikrobiologisk kvalitet sätts vid totalantalet log 7 CFU (Colony Forming Units)/g aeroba bakterier. Vid högre totalantal aeroba bakterier anses köttets mikrobiologiska kvalitet vara bristfällig. I denna pilotstudie har vi undersökt hållbarheten hos färskt vakuumförpackat renkött som kyllagrats vid +4 °C.

Material och metoder
Sex renkalvar (ålder 4 månader) ingick i undersökningen. Renarna slaktades enligt normal procedur vid Lossens renslakteri i Härjedalen, Sverige. Vid styckningen mättes köttets pH-värde i ytterfilén (*M. longissimus*) vid sista revbenet för att garantera att de renkalvar som valdes ut för vidare provtagning hade ett pH-värde lägre än 5,8 i ytterfilén. Vänster ytterfilé från de sex kalvarna delades i 5 bitar där bitarna slumpmässigt fördelades på 5 olika lagringstider; provtagning direkt efter förpackning och efter kyllagring i 2, 3, 4, och 5 veckor vid +4 °C. Alla bitar vakuumförpackades och märktes tydligt. Proverna transporterades kylda till Hjortens Laboratorium i Östersund där lagring och provtagning ägde rum. Mikrobiologiska analyser av totalantal aeroba bakterier och e-kolibakterier genomfördes enligt standardmetoder.

Resultat och diskussion
Totalantalet bakterier i köttproverna var lågt vid första provtagningen vid förpackningstillfället (log 2,1 CFU/g), men steg sedan snabbt så att efter 2 och 3 veckors kyllagring antalet bakterier var på gränsen till bristfällig kvalitet (log 6,7 CFU/g och log 6,8 CFU/g). Vid 4 och 5 veckors kyllagring hade gränsvärdet på log 7 CFU/g aeroba bakterier överskridits. Lagringstiden för färskt renkött bör därför inte överstiga 3 veckor vid en kyltemperatur på +4 °C.

Renkött säljs oftast som en fryst produkt, men flera slakt- och styckningsföretag säger att de ser en långsamt ökande efterfrågan på färskt renkött. Vid hantering, förpackning och förvaring av färskt renkött krävs ny kunskap. Faktorer som visat sig ha en stor betydelse för det färska köttets hållbarhet är pH-värde, slakthygien och kyltemperatur. Den kunskap som idag finns gäller andra köttslag, och även om de flesta principer fungerar på liknade sätt i olika typer av kött, finns det ändå anledning att undersöka framförallt effekter av kyltemperaturer och förpackningsmaterial på hållbarheten hos färskt kyllagrat renkött.

Slutsatser
De företag som idag säljer färskt vakuumförpackat renkött anger oftast en hållbarhet på 21 dagar (3 veckor). Det stämmer väl överens med resultaten från denna pilotstudie där vi kunde konstatera att lagringstiden för färskt renkött bör inte överstiga 3 veckor vid en kyltemperatur på +4 °C. Erfarenheter från andra köttslag visar att variation i kyltemperatur har en mycket stor inverkan på köttets hållbarhet, d.v.s. en garanterad hållbarhetstid på 21 dagar vid +4 °C kan förkortas eller förlängas dramatiskt om temperaturen ändras med ±2 °C.