Foredrag – Lectures (kronologisk / in chronological order) side/page

Reindriften i et historisk perspektiv: Presset utenfra og innenfra?

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Reindriften er inngående studert innen en rekke fag. Naturvitenskapelige studier har særlig fokusert på ulike sider ved beite, samt sykdom. De moderne samfunnsvitenskapene, med geografi og sosialantropologi i spissen, har i særlig grad vært opptatt av organiseringen av reindriften, med utgangpunkt i ulike modeller knyttet til vedlikehold, omstilling og endring. Rettsvitenskapen har en tradisjon tilbake til 1800-tallet innen feltet, der for øvrig ikke sjelden politikk og jus lenge ble nokså nært koblet sammen. Under påvirkning av den moderne utviklingen av urfolks- og folkeretten har rettsvitenskapen kommet stadig sterkere på banen de siste 30-40 år. De humanistiske fag har spilt en heller underordnet rolle i den spesifikke forskningen på reindriften. Språkforskningen er et unntak, der for eksempel terminologi særlig knyttet til reindriften har fått oppmerksomhet. Historiefaget kom seint på banen i studiet av reindriften, trolig på grunn av den sterke forankringen faget lenge hadde både til klassisk definerte tema og til metodologisk avgrensning, der den nasjonalstatlige rammen og den politiske historien lenge var dominerende anliggender. Da faget omsider kom på banen også innen reindriftsforskningen, var inspirasjonen fra samfunnsfagene tydelig, især ved de ulike modeller og teorier omkring samfunnsmessig organisering og omstilling.

I dette foredraget skal jeg gi et riss av reindriften i historisk perspektiv med særlig oppmerksomhet nettopp om de faktorer som har påvirket den; jeg skal særlig forsøke å fange opp og problematisere forholdet mellom det jeg har valgt å kalle for presset innenfra og presset utenfra. Framstillingen er basert på følgende premisser. For det første: Reindriften som storstilt næring har gjennom hele sin historie stått i et forhold til det omgivende samfunn; den har knapt noen gang eksistert i et etnisk eller kulturelt eksklusivt rom. For det andre: Reindriften har utvilsomt gjennom mesteparten av sin historie vært utsatt for press utenfra, av ulike slag, men ikke minst av bosettingsekspansjon og statspolitikk. Men for det tredje: Reindriften har, med stadige omstillinger og tilpasninger, også vært utsatt for interne drivkrefter, eller i alle fall forhold som en ikke uten videre kan rubrisere som eksterne. Dette fører meg over til mitt fjerde og siste utgangspunkt: Selv om historiske studier har problematisert disse ulike typer drivkrefter, er det grunn til stadig å ta dem opp til undersøkelse, ikke minst fordi forestillingene om de eksterne pressfaktorers dominerende betydning har hatt og har en sterk posisjon ikke minst i mer populære framstillinger og i media. Jeg vil kort trekke fram tre historiske eksempler til belysning og problematisering av forholdet mellom ”presset utenfra” og ”presset innenfra”, fra tre ulike perioder, fra 1600-1700-tallet, midten av 1800-tallet og mellomkrigstida, alle fra Finnmark. Det første eksemplet, fra den storstilte tamreindriftens oppkomsttid, illustrerer både at iboende forhold ved driften og ytre omstendigheter skapte press og at naturgitte forhold medvirket på dramatisk vis. Det andre eksemplet viser på den ene siden klart økt press fra statspolitikk og samfunnsutvikling, men også både motstrategier fra reindriftens side og modernitetens påvirkning og ”fristelser”. Det tredje eksemplet viser hvordan komplekse lokale forhold bidro til marginalisering av ”en minoritet i minoriteten” og til å bryte ned en særlig type samisk reindrift. Alle eksemplene vil forhåpentligvis illustrere det ofte komplekse ved historiske prosesser og minne om nødvendigheten av forsiktighet med bruk av monokausale forklaringer.

Reindeer herding in a historical perspective: strained from the outside and from within?

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Reindeer herding has been studied for a long time within several disciplines. Within science focus has, naturally, been on pasture and grazing, and on disease. Modern social sciences, first and foremost geography and social anthropology, have particularly studied organizational issues, bases on models and theories on change and continuity. Law studies have a tradition back to the nineteenth century, in which politics more often than not inflicted on the studies. The last 30-40 years have seen a renewal of the field inspired by international law and indigenous rights questions. Humanistic disciplines have played a rather modest role within the field. Linguistic studies represent exceptions, with their interest for, e.g., terminology related to reindeer herding. History is a late comer in the field, probably because of the discipline's strong linkage to classically defined themes and methods, in which the nation state's topicical frames and political history for a long time were in the forefront. When history at last entered the scene the inspiration from social sciences was evident, first and foremost the model and theories on organization and transformations.

The lecture aims at presenting an outline of reindeer herding in a *long durée* perspective, focusing on factors which inflicted on the trade. In particular, I will try to point at and question the relations between the internal and external factors stressing the trade. The presentation is based on certain hypotheses. Firstly, reindeer herding as a large scale trade has throughout its history never been isolated from the surrounding societies; it has hardly ever existed in an exclusive ethnic or cultural space. Secondly, the trade has beyond doubt been pressed from the outside world, not least by spatial expansion and state policies. However, thirdly, reindeer herding has through change and adaption also been inflicted by internal forces, or at least factors which cannot without questioning be characterized as external. Fourthly and lastly: Though historical studies have analyzed these diverse sets of forces such studies should repeatedly be renewed, in new perspectives, also because of the external factors' predominance in popular literature and in media. To illustrate my points I will draw on three historical examples, from three historical periods, the seventeenth and eighteenth centuries, the mid nineteenth century and the interwar period respectively, all three examples are from Finnmark. The first example, from the upcoming phase of large scale reindeer herding in the area, will point at internal as well as external factors inflicting on the trade, including natural conditions with catastrophical outcome for the herd. The second example illustrates increased pressure from state policies as well as from external social development but also Sami counter strategies and modern influences and "temptations". The third example will refer to complex local circumstances' contribution to the marginalization of "a minority within the minority" and to the breaking down a specific type of Sami reindeer herding, replacing it with another one. All three examples will, hopefully, illustrate the complexity of historical processes and remind us of the need for carefulness in adoption of mono causal historical explanations.

Reinens DNA som markør for overgang fra villreinjakt til tamreindrift

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Overgangen fra jeger/sanker samfunnet til jordbrukssamfunnet ansees å være blant de viktige sprang i menneskets historie. For mange av våre viktigste husdyr er i dag de ville formene av arten utryddet, noe som setter klare begrensninger for å studere den tidlige prosessen av domestisering. Reinen er blant de siste artene som er blitt domestisert og både ville og tamme reinstammer eksisterer fortsatt side om side flere steder i Eurasia. Studier av de tidlige domestiseringsprosesser hos reinsdyr vil derfor ikke bare bidra til bedre forståelse av historien til de mange reindriftkulturene, men også kunne være modell for hvorledes den tidlige domestiseringen foregikk hos andre arter. Genetiske analyser av sekvensvariasjon av mitokondrielt DNA, samt allelfrekvens variasjon i ulike DNA mikrosatellitter, hos dagens vill- og tamreinbestander gjennom Eurasia har avdekket genetiske strukturer med et klart mønster som reflekterer menneskets bruk av rein som ville eller domestiserte bestander. Den genetiske variasjonen tyder sterkt på ulik opprinnelse til den tidlige domestiseringsprosess av reinsdyr i Fenno-skandia og Russland. For å belyse denne prosessen ytterligere er det av avgjørende betydning å kunne identifisere den tidlige tamreinen i det arkeologiske materialet og plassere disse innen en sikker tidsramme. Genetiske sammenligninger av sekvensvariasjon i mitokondrielt DNA i rein fra arkeo-logiske utgravninger i sentrale reinområder fra ulike tidsperioder som strekker seg fra steinalderen og fram til dagens bestander viser at det flere steder har foregått markerte genetiske endringer. Tids-perioden for disse endringene varier mellom ulike områder og tyder på at disse er relatert til innføring av tamrein inn i tidligere villreinbestander. De genetiske undersøkelsene av det arkeologiske materialet diskuteres i relasjon til overgangen fra villreinjakt til tamreindrift.

DNA in reindeer as marker for transition from hunting to use of reindeer as domesticates

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The transition from hunting to farming and herding is considered to be among the great jump in human history. An important limitation in the study of the Reindeer are considered to in the early phase of domestication with wild and domestic herds still coexisting widely across Eurasia. Analyses of the early domestication process of reindeer will contribute not only to an better understanding of the recent history of the many reindeer herding people, but also as a unique model system for under-standing how the early domestication process may have taken place. Genetic analyses of both mitochondrial DNA sequence variation and allele frequency distribution of various DNA micro-satellites of contemporary wild and domestic reindeer populations through Eurasia have revealed genetic structure with distinct pattern reflecting varying human use of the reindeer as domestic or wild animals. The genetic variation suggests different origin of the early domestication process of reindeer in Fennoscandia and Russia. Central to addressing this process is the ability to identify early domesticates in the archaeological record and to place them within a secure temporal context. Genetic comparisons of mitochondrial DNA variation in reindeer material from archaeological excavations spanning from the Stone Age to contemporary material reveal that an extensive genetic change has occurred in several central reindeer areas in Norway. The time frame of the genetic change varies in different reindeer areas and appears to be related to introduction of domestic reindeer into previous wild populations. The genetic analyses of the archaeological material are discussed in relation to the transition from hunting to use of reindeer as domestic animals.

Kan arkeologien bidra i diskusjonen om overgangen til tamreindrift?

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Vår kunnskap om innlandets eldste historie i Nord-Norge er ennå svak, og det er grunn til å stille spørsmål om det eksisterende grunnlaget er representativt. Selv om det i den senere tid er kommet til noen få nye arkeologiske arbeider, er det svært mye som gjenstår. Vi vet ennå lite om hvilke kulturminner som finnes, hvordan de er lokalisert i landskapet, og hvordan de er kronologisk relatert til hverandre, og dette gjelder særlig periodene fra 3000 f.Kr til 1000 e.Kr. I dag pågår det et større arkeologisk forskningsprosjekt (LARM) ved institutt for arkeologi og sosialantropologi ved UiT. LARM har som mål å få ny erfaring og kunnskap om dynamikk i landskapsforståelse og ressursutnytting innenfor jakt, fangst og tidlige reindriftssamfunn i indre Troms og Finnmark.

Hva kan så arkeologiske resultater bidra til kunnskap om jakt, fangst og tidlige reindriftssamfunn? I eget dr.gradsprosjekt har jeg særlig sett nærmere på den begrensede kunnskapen man har om Indre Troms i tiden før koloniseringen på 1800-tallet. Utgangspunktet er at innlandsområdene har betydd mye for samiske samfunn som fra jernalderen av hadde jakt, fangst og fiske som hovednæring. Etter hvert gikk man over til tamreindrift, som siden har utgjort den økonomiske og kulturelle basis for mange samiske samfunn i generasjoner. Dette innebærer å se nærmere på endringene fra jakt og fangst på villrein til spørsmål om når og hvorfor man gikk over til tamreindrift fra 1400-tallet av. Gjennom ulike forvaltningsprosjekt og utgravninger er det nå registrert 445 samiske kulturminner i de militære skytefeltene Mauken og Blåtind og i et eget undersøkelsesområde, Devddesvuopmi i Dividalen. Det empiriske materialet i avhandlingen utgjør 31 arkeologisk undersøkte boplasser og fire såkalte ”stallotufter”(boplasser), datert fra vikingtid og frem til ny tid. Boplassmaterialet er sett i sammenheng med reindriftslandskapet som har en kulturell verdi og gir landskapet innhold der også hellige steder og offersteder er viktig.

For å belyse boplassenes kontekst i landskapet er det viktig å se nærmere på reindriftskunnskap og reindriftspraksis, begreper som er sentrale for å bringe inn en annen forståelse for hvordan kontinuitet og endring kan sees i forholdet mellom menneske, rein og reinbeitelandet. Totalt utgjør kulturminnematerialet fra Indre Troms et unikt empirisk tilfang for samisk historie, og dette viser at arkeologiske undersøkelser er avgjørende for å sette reindriftsboplassene inn i en kronologisk og kulturell kontekst som viser at det har foregått ulike former for reindrift gjennom tid. Arkeologiske undersøkelser i reinbeitelandskapet bringer inn og gir grunnlag for ny kunnskap om samisk bosetting og ressursbruk i innlandet.

Archaeology and the debate on the transition of hunting reindeer to reindeer husbandry?

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The last two decades have seen a growing interest in Sami history and archaeology in Scandinavia but has not been followed up by research in interior North-Norway. During the last few years, individual projects has been conducted in the interior of Finnmark and Troms counties by some few researchers. Most of them have focused on the Stone Age-Early Metal Age material, and only one PhD-project has recently given attention on the transition from hunting to reindeer husbandry.

The cultural diversity by the Sami in the interior is reflected today in various types of monuments in the landscape such as offering sites, holy mountains, dwellings and hunting-pit systems, in oral traditions and in place-names. A few archaeological projects have provided a better knowledge base for central chronological periods and geographical areas in Sami past, but still there is a need for more research. One major empirical challenge is that, the interior is sparsely investigated archaeologically.

Although the representivity of the existing material is questionable, use of the interior seems to intensify about 2500 BC, in the form of larger and different types of dwelling sites and large wild reindeer hunting-pit systems. The ongoing LARM-project at the University of Tromsø (Landscape and Resource Management in Interior Arctic Norway 2500 BC – AD 1000) investigates change and continuity in this period. The chronological scope encompasses three assumed major changes in past resource management in the region of Finnmark and Troms, both which had broader implications for the culture-history of northern Fennoscandia at large. First is the establishment of large pit-fall systems for hunting wild reindeer from around 2500 BC. Second is the transition to hunting-based reindeer herding, possibly as early as AD 800/1000, and later, from AD 1400 and onwards, the Sami migrated annually with their reindeer herd from the interior east of the Swedish & Norwegian border (settled in 1752) to the coast.

Archaeological landscape surveys and excavations, supplemented by comprehensive use of 14C/AMS-dating, pollen-analytical and soil-chemistry investigations, as well as re-evaluations of existing archaeological material will contribute to the debate on the transition of hunting reindeer to reindeer husbandry. It will also bring in new data for achieving better knowledge and better managing of culture resources, and new data will also focus on the articulation of scientific archaeological knowledge and traditional local Sami landscape engagement. Today Sami place names and local knowledge is an important archaeological practice, in order to expand our interpretive resources for the past. The main goal in the LARM-project is to investigate how hunting/herding landscape knowledge and resource management is related to multiple dimensions of changing and maintaining identity (ethnicity, territoriality, gender).

Changing in reindeer number in Russia: political context or climatic impacts?

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The report is based on the analyses of domesticated reindeer number trends at federal, regional, and local levels together with interviews with herders in different northern regions of Russia.
During last century domesticated reindeer population in Russia experienced important changes from 1,2 (min) to almost 2,5 (max) million deer. Changes in natural environment including climatic ones produced relatively small impacts on reindeer number dynamics. The most important trends and fluctuations were connected with changes in social and economic environment that followed political directives of the Russian government.
1). The collectivisation (the 1930s) produced the important decrease of reindeer number (to 65%).
2) The sedentarization (the1930s-1960s) resulted in serious social and economic changes which influenced the dynamics of reindeer number later (in the1980s -1990s).
3) Development of modern transport (in the1950s -1970s) resulted in the decrease of reindeer number in regions where reindeer were used mostly as transport animals.
4) Post-soviet reforms with dramatic social changes and economic crises in the 1990s resulted in nearly twice as great fall down of total domesticated reindeer number.
5) The revitalization of reindeer husbandry due to regional budgets support in the 2000s resulted in the restoration of the total number of reindeer in Russia (1 552 900 heads at 1 January 2010).
Dramatic impacts on reindeer number dynamics produced by the political context hinder the possibility to pick out the influence of natural drivers including impacts of climatic changes. However, one can assume that a gradual increase of reindeer population in the north-eastern part of Russia in the 1960s could be connected with changes of atmospheric circulation patterns in the second part of the XXth century. These changes resulted in the predomination of cold and windy weather in summer all over Siberian and Far East tundra regions. Cold and windy summers are favourable for reindeer. Indeed, it was the time of the rapid growth of wild reindeer populations in Taimyr, Northern Yakutia and Chukotka, which were completely out of political context opposed to domesticated herds.
In its turn, the growth of wild reindeer populations resulted in migrations of huge wild reindeer herds throughout domesticated reindeer pasture lands. It caused problems to herders and depressed reindeer husbandry in many regions up to the complete loss of domesticated reindeer in several areas.
Thus, changes in natural environment (and probably climatic changes) did produce dramatic negative impact on reindeer husbandry. This impact was limited by several areas in the North-East of Russia.
More detailed analysis revealed the important difference between reindeer number trends in two main institutional forms of reindeer husbandry: enterprises with reindeer in common ownership (i.e. kolkhozes, sovkhozes, municipal enterprises, etc.) and households with family owned reindeer.
To go over the main points I am going to list different kinds of domesticated reindeer number trends in Russia during last 50 years:

1. Trends due to natural environment changes
   - Feeble trends, probably connected with gradual climatic changes (the North-East of Russia).
   - The dramatic decrease of domesticated reindeer number due to the expansions of the large wild reindeer populations (limited areas in Taimyr, Northern Evenkia, Yakutia, Chukotka).

2. Trends due to changes of social environment
   - The gradual decrease of reindeer number due to the replacement of reindeer transport by modern transport facilities (taiga regions).
   - Trends caused by political changes in the 1990s
     - trends of reindeer number in enterprises: a) the dramatic fall down in the north-eastern part of Russia; b) the slight decrease in the north-western part of Russia; c) the collapse of reindeer enterprises in taiga regions; d) the restoration of reindeer number due to regional support;
     - trends of reindeer number in households: a) short-time fluctuations due to privatization in the 1990s; b) a stable increase in Yamal and Gydan areas; c) a stable decrease in most parts of all other regions.

Changing in reindeer number in Russia: political context or climatic impacts?

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The report is based mainly on the analysis of domesticated reindeer number trends at federal, regional, and local levels. Besides statistics, important information was collected from interviews with reindeer herders, their families, managers of reindeer herding enterprises and local decision makers during the author's numerous trips in northern regions, including Kola and Kanin Peninsulas, Kolguev Island, Yamal, Taimyr, Yakutia, Chukotka, Tukukhansk and Bodaibo districts.

General analysis of federal level trends revealed a close connection between reindeer number dynamics and political context. More detailed regional and local levels analysis revealed the way general changes in social and natural environment influenced various kinds of reindeer husbandry in different parts of Russia.

Last century domesticated reindeer population in Russia experienced important changes from 1,2 (min) to almost 2,5 (max) million deer. Changes in natural environment including climatic ones produced relatively small impacts on reindeer number dynamics. The most important trends and fluctuations were connected with changes in social and economic environment that followed political directives of the Russian government:

1) The collectivisation (the 1930s) produced the important decrease of total reindeer number (to 65%).
2) The sedentarization (the 1930s-1960s) resulted in serious social and economic changes which influenced the dynamics of reindeer number later (in 1980s-1990s).
3) Development of modern transport (1950s-1970s) resulted in reindeer number decreasing in the regions where reindeer were used mostly as transport animals.
4) Post-soviet reforms with dramatic social changes and economic crisis in the 1990s resulted in nearly twice as great fall down of total domesticated reindeer number (in the North-East of Russia in about 3-5 times as great).
5) The revitalization of reindeer husbandry due to regional budgets support in the 2000s resulted in restoration of the total number of reindeer in Russia (1 552 900 heads at 1 January 2010).

The important social, economic and institutional shifts listed above affected not only reindeer husbandry, but all branches of rural economy. We can conclude it from the diagram (Fig. 1) which compares reindeer and cattle (cows) number dynamics in Russia (scales are normalized for better comparison). Reindeer husbandry and cattle breeding are completely different industries. They differ in their spatial localization (in main reindeer husbandry areas cattle breeding is absent), in engaged labour force, in management system and institutional structure, in markets, etc. However, main trends, peaks and depression periods of both curves are very close. This suggests that internal political context played the key role and affected both kinds of animal breeding in the same way. The main difference in reindeer and cattle number dynamics was the absence of the restoration of cattle number during the last decade. The financial support of reindeer husbandry in the 2000s provided mainly by regional authorities was partly due to political activity of indigenous NGOs, and that gave reindeer husbandry some advantages as compared to cattle breeding.

Dramatic impacts on reindeer number dynamics produced by the political context hinder the possibility to pick out the influence of natural drivers including impacts of climatic changes. However, one can assume that a gradual increase of reindeer population in the north-eastern part of Russia in the 1960ies could be connected with changes of atmospheric circulation patterns in the second part of the XXth century. These changes resulted in the predomination of cold and windy weather in summer all over Siberian and Far East tundra regions, from Ural Mountains to Chukotka (Kononova, 2009). Cold and windy summers are favourable for reindeer. Indeed, the rapid growth of wild reindeer populations

in Taimyr, Northern Yakutia and Chukotka occurred in the 1960s-1970s. Wild reindeer were completely out of political context as opposed to domesticated herds.
In its turn, the growth of wild reindeer populations resulted in migrations of huge wild reindeer herds throughout domesticated reindeer pasture lands. It caused problems to herders and depressed reindeer husbandry in many regions up to the complete loss of domesticated reindeer in several areas (Ulvevadet & Klokov, 2004: 83).

Thus, changes in natural environment (and probably climatic changes) did produce dramatic negative impact on reindeer husbandry. This impact was limited by several areas in the North-East of Russia.

Detailed reindeer number trends analysis was made on the basis of the reindeer husbandry typology and division of the territory of the Russian North into small Ethno-Ecological Areas. Reindeer husbandry in Russia is various and includes several quite different economic patterns in diverse natural and social environment. One can assume that the response of different kinds of reindeer husbandry to the same external impacts should not be similar. For this reason I am going to identify most important institutional, ecological and ethno-cultural types of reindeer husbandry in Russia.

Institutional types of reindeer husbandry

Before the collectivization, reindeer herding in Russia was based on households (family economies) with most of herder families living as nomads. In the result of collectivization and sedentarization most households were united into collective reindeer herding enterprises (hereafter REs) named kolkhozes. Later kolkhozes were transformed into state enterprises (sovkhozes, municipal enterprises, etc.). Most of domesticated reindeer, therefore, were subjected to collective or state ownership. Herders and their families worked in brigades for REs. Brigades usually included from 4 up to 7 families, which completed the annual cycle of one herd, and throughout that process kept a close connection to reindeer despite the fact that the animals were not their private property. REs are the main specific institutional type of reindeer husbandry in Russia, there is no REs in Scandinavian countries (Norway, Finland and Sweden).

Besides REs, reindeer herding households (RHs) exist in Russia as well. In several areas, mostly in the Northern part of Western Siberia, an important part of herder households did not enter into REs and continued the independent husbandry despite the suppression of local authorities. In some districts RHs own the most part of reindeer. On the contrary, in some other regions (for example, in Chukotka) there are only a few reindeer owned by RHs while REs play a leading role.

The main formal difference between REs and RHs is that REs have a status of a juridical persons, but RHs do not. REs are managed by state agencies and regularly receive a considerable state support. On the other side, RHs are more independent from the state agencies and regional authorities, but they are not supported by the state to a considerable extent. Actually, RHs are self-managed family economic units mostly focused on subsistence. As a rule, they are not registered as tax-payers and they don't have any legal rights for pasture lands and are very restricted in resources access. In taiga households use domesticated reindeer mostly for transportation needs having very small herds. They don't slaughter domesticated reindeer and earn money by selling meat of wild reindeer and skins of fur animals. However, in tundra rich herders often have several hundred or more domesticated reindeer and they slaughter domesticated animals to sell meat.

It should be noted, that in the result of the post-soviet reformation institutional structure of reindeer husbandry became much more variable as compared to the soviet time. In the 1990ies nearly all REs were reorganized. In some cases, REs' common herds were divided between RHs and then part of the RHs were united into associations named "clan communities" ("*obschiny*" in Russian). It could be perceived as something like the "post-soviet collectivization". At present only a part of clan-communities are operating as associations of RHs. Many of them are really operating as REs (i.e. they differ from RHs only on paper).

The main point is that during soviet and post-soviet periods reindeer number trends in REs and RHs were quite different and in some regions even the opposite (fig. 2; Klokov, 2007: 739-740). This fact proves the importance to distinguish between RE's and RH's institutional types of reindeer husbandry.

Ecological diversity of reindeer husbandry

Ecological types of reindeer husbandry differ first of all in size of herds and seasonal patterns of pasture land use in different landscapes. Ecological diversity is closely connected with economy. Each ecological type has its own economic strategy. Large herd reindeer husbandry with summer and winter pastures situated at big distances in different landscape zones (tundra – forest-tundra – taiga) is mainly focused on meat production. Husbandry with small reindeer herds without long migration meets mostly subsistence and/or cultural needs of herders' families. It is typical for taiga areas and mountainous regions. Between theses two main types there are many intermediate ones.

Ethnic and cultural diversity of reindeer husbandry

From ethnic and cultural point of view there were five types of reindeer husbandry in Russia (Vasilevich and Levin, 1951):

- Samies type (only Samies on Kola Peninsula),
- Samoeds type (Nenets, Komies, etc. mainly in the western part of the tundra and taiga),
- Chukchi-Koriaks type (in the eastern part of the tundra),
- Tungus type (Evenks, Evens, Yakuts, etc. in the eastern part of taiga)
- Saian type (only Tuvins and Tofalars in the Central Siberian taiga).

Cultural features of reindeer husbandry are closely connected with its natural environment, because historically each ethnic group developed its traditions in concrete natural landscape. Thus, Samoeds and Chukchi-Koriaks cultural types are two different versions of tundra large herd type with long migrations, and Tungus and Saian cultural types are two versions of taiga small herd ecological type.

Ethnic and cultural traditions of reindeer herding peoples are still significant in the context of economic and social changes. During the period of post-soviet reforms with the sharp changes of social environment ethnic traditions greatly influenced herders' choice of economic strategies and ways of adaptation. Interviews gave the opportunity to understand what ways of adaptation herder communities had chosen to survive in changing social environment and what strategies were typical for herders with different ethnic traditions in different regions. It is possible to identify at least three adaptive strategies (Klokov, 2000):

a) to escape the official control of state agencies and local administrative governance (i.e. to try to be "invisible");
b) to cooperate with local administration without resisting modernizations of the way of life;
c) to try to install formal links with legal institutions of dominant society and to be integrated in social and economic systems leading in the same time the traditional way of life.

All above mentioned reindeer husbandry types are interrelated. Husbandry of each concrete community can be perceived as a superposition of several classifications. For example, reindeer husbandry in the western part of Kanin Peninsula can be attributed:

1) to the ecological type of large herd husbandry with long seasonal migrations from tundra to taiga,
2) to the Samoeds cultural type (however, with several local peculiarities),
3) to the combination of both institutional types (RHs and REs) with the predominant role of RHs (family households formally united in the association – *obschina "Kanin"*).

To make a relevant ground for detailed analysis of regional trends in reindeer number I divided the territory of the Russian North into several Ethno-Ecological Areas (EEAs) according to the similarity of reindeer number trends during last 50 years. Reindeer husbandry of each EEA can be attributed to definite ecological, cultural and institutional types. Comparing the reindeer number trends in EEAs with diverse types or reindeer husbandry one can suggest probable reasons and drivers responsible for different kinds of the trends.

To go over the main points I am going to list different kinds of domesticated reindeer number trends in Russia during last 50 years:

1. Trends due to natural environment changes.
   - Feeble trends, probably, connected with gradual climatic changes (the North-East of Russia).
   - The dramatic decrease of domesticated reindeer number due to the expansion of the large wild reindeer populations (limited areas in Taimyr, Northern Evenkia, Yakutia, Chukotka).
2. Trends due to changes of social environment.
   - The gradual decrease of reindeer number due to the replacement of reindeer transport by modern transport facilities (taiga regions).
   - Trends caused by political changes in the 1990ies:
     - trends of reindeer number in enterprises:
       - a) the dramatic fall down in the North-Eastern part of Russia;
       - b) the slight decrease in the North-Western part of Russia;
       - c) the collapse of reindeer enterprises in taiga regions;
       - d) the restoration of reindeer number due to regional support;
     - trends of reindeer number in households:
       - a) short-time fluctuations due to privatization in the 1990ies;
       - b) a stable increase in Yamal and Gydan areas;
       - c) a stable decrease in most parts of all other regions.

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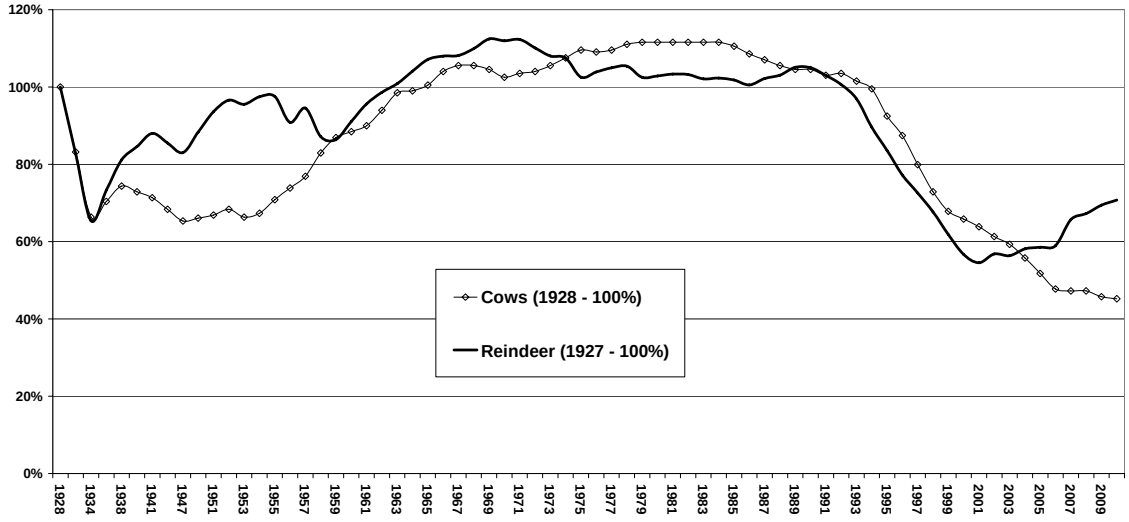

Fig. 1. Comparative dynamics of reindeer and cows number in Russia.

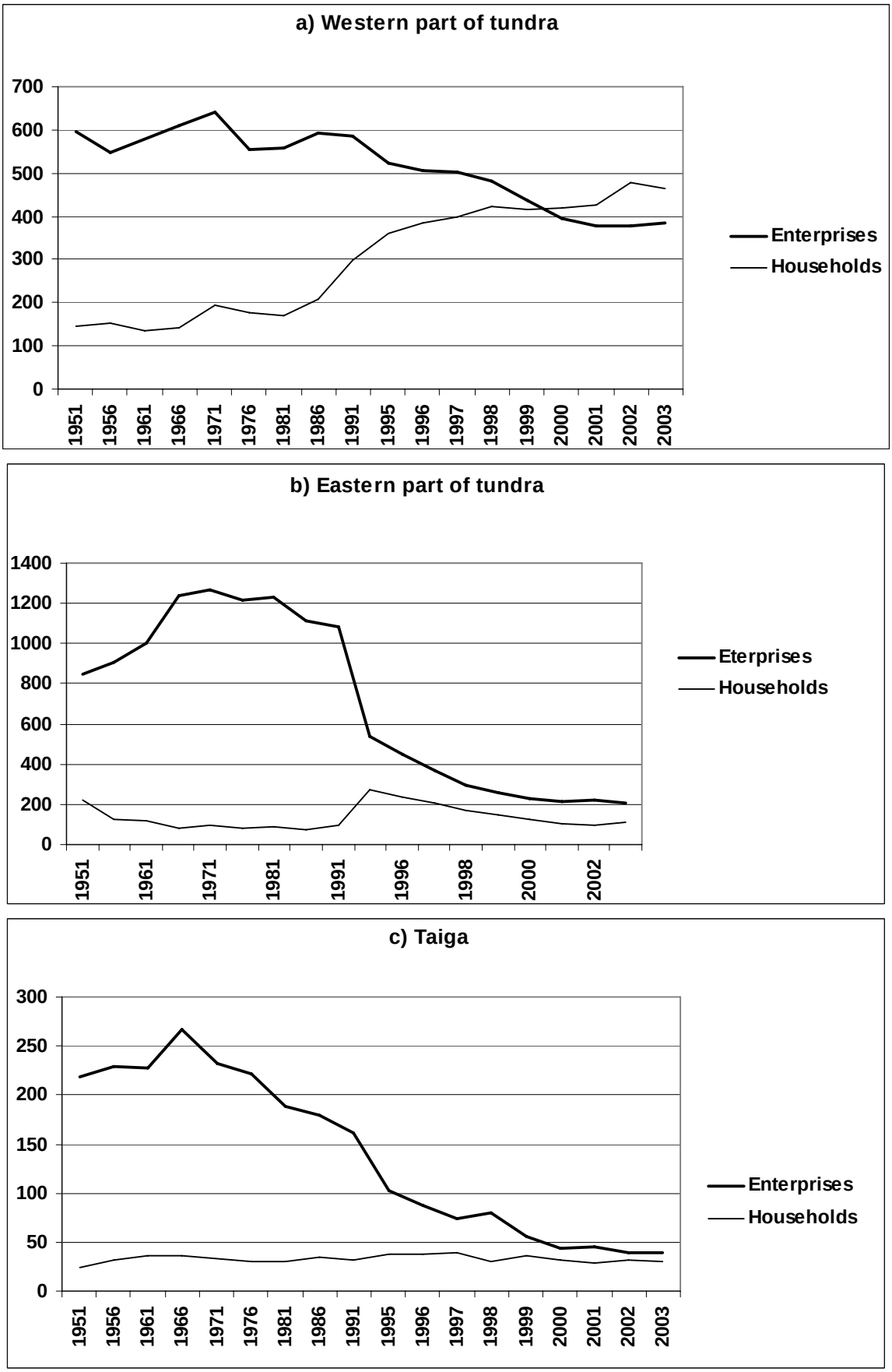

Fig. 2. Dynamics of reindeer number in reindeer enterprisers and households in different parts of Russia, animal number in thousands.

Boazodoalu sirdin Sámis Ruonáeatnamii

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Árbevirolaččat ii gávdnon boazodoallu Davvi-Amerihká kontineanttas, muhto doppe leat leamaš gottit maid olbmot árbevirolaččat leat bivdán. Loahpageahčen 1880-logu álggahuvvui boazodoallu Alaskai, mii lei USA territoria, ja maŋŋelaš máŋgga iešguđetge guvlui Kanadai. Ruonáeatnamii maid álggahuvvui boazodoallu dán ovddamearkka mielde 1952:s, go 300 bohcco ostojuvvo ovtta Kárášjoga siiddas, ja dolvojuvvo fatnasiin Nuuk-vutnii.
Dánskka stáda ulbmil buktit bohccuid Ruonáeatnamii ja álggahit boazodoalu dohko, lei vuođđudit ođđa dehálaš ealáhusa ja háhkat bargosajiid olbmuide. Plána lei ahte Dánskka stáda galggai álggos eaiggádit ealu, mii dađistaga galggai privatiserejuvvot Ruonáeatnanlaš inuihtaide.
Sámi boazobargit geat eatnasat ledje Norggas, Finnmárkkus fylkkas eret, bálkáhuvvo bargat guođoheaddjin ja maid oahpaheaddjin Ruonáeatnanlaš oahpahalliide. Sámi boazobargit barge aktiivvalaččat Ruonáeatnama boazodoalus jagiid 1952-1978. Maŋŋel dán de oste Kapisillit gili ássit ealu Nuuk-vuonas ja barge dainna báikkálaš oasusfitnodagas gitta 1998 rádjái go eallu vuvdojuvvui Nuuka suohkanii. Dát mearkkašii ahte Nuuk-vuona boazodoallu nogai, ja dán guovllus lei maiddái ealát visot nohkan ja eanan guorban. Boazodoallu ii lihkostuvvan šaddan stuora ealáhussan Ruonáeatnamis nu go eiseválddiin lei ulbmil, ja das ii lean nanaguoddevaš ovdáneapmi. Odne lea dušše guovtti bearrašii Lulli-Ruonáeatnamis boazodoallu váldo sisaboahtun.
Mii dáhpáhuvvo go árbevirolaš sámi máhttu sirdojuvvo eará kultuvrralaš ja ekologalaš kontekstii? Nuuk-vuona "sámi áigodagas", de lei boazodoallu seammalágan go Sámis ja erenoamážit Finnmárkkus, gos sii čuvvo boazodoalu dábálaš jahkejuvlla, muhtin heivehemiiguin Ruonáeatnama dilálašvuhtii. Sii guođohedje ja čuige ealu, sii johte gaskkal dálve- ja geasseorohagaid, sii njuvve čakčat ja dasa lassin doppe ledje ollu iešguđetge dehálaš barggut boazodoalu jahkejuvlla siskkobealde.
Árbevirolaš máhtu sirdin sámi boazobargiin Ruonáeatnanlaš oahpahalliide dáhpáhuvai árbevirolaš sámi vuogi mielde, sullii seamma vugiin dego livččet reaŋgga oahpaheame boazobargguide. Ruonáeatnanlaš oahpahallit čuvodedje sámi oahpaheddjiid bargguid siste, ja ohppe bargat praktihkalaš vuogi mielde. Máŋga oahpahalli šadde oalle čeahpes boazobargit, muhto muhtimat eai lean nohka movttiidahttojuvvon ja sis váillui mokta joatkit boazobargin boazodoalus.
Doaivumis leat máŋga ákka manin boazodoallu ii šaddan dehálaš ja nanaguoddevaš ealáhussan Ruonáeatnamis. Ruonáeatnamis lea bivdokultuvra mas ii leat guođohanárbevierru. Dát lea várra čuohcan boazodoalu ovdánahttimii, ja lea dávjá čilgejuvvon váldosivvan manin boazodoallu ii lihkostuvvan Ruonáeatnamis. Muhto mun doaivvun ahte ákkat leat máŋggabealagat: Boazobargiid mielas ruonáeatnanlaš oahpahalliid oahpahallanáigodat lei menddo oanehaš, Dánskka stáda hálddašii ja stivrii boazodoalu nana gieđain eanandoalu modealla mielde- ja sis lei unnán máhttu boazodoalloealáhusas, ja doppe eai lean bearrašat oktan nissoniiguin ja mánáiguin mielde jahkásaš boazobargguiguin.

Transmission of reindeer husbandry from Sapmi to Greenland

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Traditionally reindeer husbandry has not existed in North America but the hunting of wild caribou has been in practice for centuries. In the late 1880s reindeer husbandry was introduced into the Alaskan territory of the US and later to several areas in Canada. Following this example, reindeer husbandry was introduced to Greenland in1952 when three hundred domesticated reindeer where purchased from a reindeer pastoral district or 'siida' in Kárášjohka (Karasjok) and transported to Greenland by boat to the Nuuk fjord.

By introducing domesticated reindeer to Greenland, the Danish state intended to establish an abundant new industry and create jobs for the people. The plan was that the domesticated reindeer herd would be owned by the Danish state but eventually the reindeer husbandry industry would be privatized and run by native Greenlanders.

Sami herders, mostly from the Finnmark region of Norway, where employed for their expertise on reindeer husbandry and employed as trainers for the Greenlandic apprentices. The Sami herders were an active part in Greenlandic reindeer husbandry between 1952 and 1978. After that, reindeer husbandry in the Nuuk fjord was taken over by the residents of the Kapisillit village and run as a local co-operative until 1998 when the herd was sold to the Nuuk Municipality. This ended the reindeer husbandry in the Nuuk region that also was heavily overgrazed. Reindeer husbandry did not succeed as the Danish authorities had originally intended and did not flourish as a sustainable industry in Greenland. Today there are only two families, who are located in the southern part of Greenland, that have reindeer husbandry as their main income.

What happens when traditional Sami knowledge is transferred into a different cultural and ecological context? During the 'Sami period' in the Nuuk fjord, the reindeer husbandry was practiced in a similar manner to Sapmi and specifically Finnmark by following the reindeer husbandry yearly cycle with some adaptations to the Greenlandic context. The Sami tradition entails intensive herding with seasonal movements between a summer and a winter pasture, slaughtering in the fall and a variety of other vital activities within the yearly cycle.

The transmission of reindeer herding knowledge from Sami herders to Greenlandic apprentices was done in a traditional Sami way by following the examples of training the 'reaŋga', a person brought into the siida to help with reindeer work, learning the work in a practical way. The apprentices became quite skilled as herdsmen, but some few had not enough incentive to continue in reindeer husbandry.

There might be several reasons why the reindeer husbandry did not become an abundant and sustainable industry in Greenland. In Greenland, you have a hunting culture and not a tradition of herding. This has most probably affected the development of the reindeer husbandry, and is often described as the main reason for the failure of reindeer husbandry in Greenland. But I believe the reason is complex: The training period for the Greenlandic apprentices was considered too short, the Danish state administrated the reindeer project firmly, following an agricultural model with little knowledge of reindeer husbandry, and there were no families with women and children involved in the activities within the yearly work with reindeer.

”Den nye tid” – endringer og utfordringer for reindriften

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Den ”nye tid” har forandret reinnomadens liv fullstendig. Mekanisering og pengehushold har ført til at samspillet mellom dyr, natur, og mennesker brytes opp og forsvinner mer og mer. Dette er en utvikling som skaper nye og store utfordringer for reindriften.
Det er i hovedsak to typer problemer næringen står ovenfor, de naturskapte, og de menneskeskapte utfordringer. Reinen har overlevd i mange tusen år her nord, og vist en stor tilpasningsdyktighet. Selv om vi ser moderate endringer i klima og andre naturforhold, er det grunn til å tro at reinen fortsatt vil gi oss mat, klær, og inntekt i mange generasjoner framover. Men dette forutsetter en driftsform på dyrets premisser.
Reinen trenger store arealer. Dette er selve kjernen til de mange konflikter vi ser i dag, og som truer næringens fremtid. Gruvedrift, vindmøller, kraftutbygging, hyttefelt og lignende ”spiser” opp beitelandet bit for bit. Det blir ”trangt” på vidda, noe som kan være katastrofalt på sikt.
Ett annet stort problem er rovdyrpolitikken. En rovdyrstamme i vekst tar mer og mer rein på beite. I mange siidaer går produksjonen i hovedsak til å mette rovdyr. Dette må være galt, men det er en villet politikk fra våre myndigheter. Dette må endres, og det er viktig å få avklart hvilke forpliktelser Norge har ovenfor sin urbefolkning, spesielt sett i lys av Grunnlovens sameparagraf. Storting og Regjering har sagt at reindriften skal være selve bærebjelken for samisk språk og kultur. Det er en tung bør som er lagt på ett lite folk. Men, skal dette ha en mening, må også det materielle grunnlaget sikres. Det totale presset fra storsamfunnet skaper ikke bare praktiske og økonomiske problemer, men også juridiske, sosiale, og medisinske utfordringer.
Det er derfor å håpe at fremtidig forskning blir lagt opp bredt, slik at alle disse problemstillinger kan fanges opp. Vi som jobber på fjellet føler nok at både gjeteren og forskeren vet mye om reinen som dyr, men mindre om mennesket som er satt til å passe på den.

“A new era” – changes and challenges for reindeer husbandry

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The life of the nomads has been completely changed with the mechanization and monetary household resulting in diminishing bounds between man, animals and nature. The modern development creates new and rather big challenges for reindeer husbandry.
The reindeer industry faces two main treats, the natural ones and those made by humans. The reindeer has survived in thousands of years and its adaptability is great. Even with climate and other natural changes reindeer herders have confidence in the reindeer to give them income, clothing and food also for future generations. But a vital condition for this to happen will be a reindeer husbandry in terms with the animal.
The reindeer need pasture areas, and this fact is the core element in almost all conflicts the reindeer husbandry experiences today: mining, wind and water energy plants, recreational activities and cabins and so on are all stealing the pasture resources. In the times to come, protecting the pasture areas will be pivotal for the future existence of reindeer husbandry. Another big issue is the predator question. The reindeer husbandry is really the dish of food for preserving animals of prey. The urban societies impose those costs on the reindeer industry. This injustice has to be changed, especially in the light of the commitments towards the Sami people to protect and advance the material basis for Sami culture. The urban society creates not only practical and economic problems but also challenges concerning justice, health and social welfare.
Future research must be broadly framed to include the mentioned approaches. We who are working out in the mountains feel that both the herder and the researcher have much knowledge about the animal reindeer but probably much less about those who are placed there to look after them.

Renskötsel i en föränderlig värld

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Den tekniske utviklingen i reindriften har gått relativt sett svært fort. Men grunnfundamentet i driften er som før, dvs at reinen som dyr styrer beitingen og reinens selektive beitemønster styrer reindriften i hvert lokale reindistrikt (S: samebyer, N: reinbeitdistrikter, SF: paaliiskunnat). Tidligere var kontakten med samfunnet ellers ikke så frekvent, og reindriftens bruk av beitemarkene kunne skje i relativt sett lite fragmenterte områder. De tekniske mulighetene og samfunnsutviklingen generelt har bidratt til lettere drift og integrasjon i samfunnet. Men utviklingen i samfunnet med utnyttelse av naturressurser (malm, skog, vann, vind) og økt fritidsbruk av naturen (friluftsliv, turisme) bidrar også til innskrenkning og fragmentering av reindriftens beitemarker. Utfordringene i dag består i å beholde intakte beiter, reindriften må får større påvirkningsmuligheter overfor arealkonkurrerende virksomheter og aktiviteter, og man må se reindriften som en positiv ressurs for samfunnet.

Reindeer husbandry in a changing world

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The technical development has been quite fast in reindeer husbandry but the foundation of Sami pastoralism is basically the same with the animal tracing the plants on the grazing land and this selective grazing rules the running of husbandry in each local district [Sami villages(=areas) in Sweden, reindeer herding districts in Norway, and paaliiskunnat (local associations of reindeer husbandry) in Finland]. The reindeer husbandry was earlier less influenced by the majority society and the grazing areas were mostly intact. This situation has changed with the incorporation in the well-fare states. The modern resource use (minerals, forests, water, wind) and increased recreational use of the pasture land (outdoor life, tourism, sport) restrict seriously the grazing in the different seasonal landscapes of reindeer husbandry. The main challenge today will be to keep big enough areas for reindeer herding. In order to fulfil this necessity, reindeer husbandry must have much bigger possibilities to influence on competing activities in the reindeer districts: The majority society should look upon reindeer husbandry being a positive contribution and part of the society as a whole.

Miksi Suomessa ruokitaan poroja?

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Poronhoidon pitäisi perustua Suomessakin luonnonlaitumiin. Ennen vain ajoporoja ruokittiin jäkälällä ja heinällä. Vaikeina talvina kaadettiin luppopuita (pääasiassa kuusia) tai pudoteltiin puista luppoa poroille. Lisäruokinta aloitettiin poronhoitoalueen etelä- ja keskiosissa jo 1960-luvulla, ja nykyään poroja ruokitaan Pohjois-Sallaa lukuun ottamatta kaikissa paliskunnissa. Poroja ruokitaan vasotus- ja erotusaitauksiin, talvisin tarhaan ja maastoon. Poroille annetaan pääasiassa heinää, säilörehua ja teollisia rehuja. Nykyään tarhoja on noin 1600 ja keskimäärin 50 poroa/tarha. Tarharuokinta keskittyy poronhoitoalueen eteläosaan, jossa poronhoitovuonna 2007/08 noin 77 000 poroa (>71% alueen eloporoista) oli tarharuokinnassa keskimäärin 90 vrk. Tarhauspäiviä oli lähes 8 miljoonaa. Poronomistajien ikääntyminen ja petovahingot ovat lisänneet porojen tarhausta. Yli 55-vuotiaiden poronomistajien poromäärät ovat lisääntyneet eniten, heillä oli jo yli 20% kaikista eloporoista. Maastoruokinta oli yleisintä poronhoitoalueen keski- ja pohjoisosissa. Vuonna 2007/08 noin 75 000 poroa (>60% alueen eloporoista) oli maastoruokinnassa. Noin 18 milj. kg teollisia rehuja ja yhteensä yli 40 milj. kg rehua kuivaksi heinäksi laskettuna käytettiin porojen ruokintaan. Lisäruokinnan kustannukset olivat yli 28% teurastulon (13 miljoonaa euroa) arvosta.
Poroja on ruokittu Suomessa pääasiassa huonojen talvilaidunten vuoksi. Jo 1970-luvun puolivälissä kangasmailla jäkäliköt olivat erittäin kuluneita poronhoitoalueen keski- ja eteläosissa (keskibiomassa 85 kg kuiva-ainetta/ha)(Mattila & Mikkola, 2009). Katotalvet ja peltojen paketointi lisäsivät ruokintaa paliskunnissa, joissa oma rehuntuotanto ja porojen ruokintamahdollisuudet olivat hyvät. Ruokinta levisi myös pohjoisiin paliskuntiin, joissa ei ollut lainkaan tai vain vähän luppoa mutta jäkälää vielä >600 kg/ha. Vuonna 2004 jäkälää oli enää keskimäärin 200 kg/ha (Mattila 2006), vuonna 2008 parhaimmillakin jäkäläkankailla <300 kg/ha (Kumpula ym., 2009). Suurien kansallis- ja luonnonpuistojen ja myös erämaa-alueiden jäkäliköt olivat voimakkaasti tai erittäin voimakkaasti kuluneita (jäkälää <100-300 kg/ha) ja porojen saatavilla oli luppoa <4 kg/ha (Jaakkola ym., 2006, Nieminen 2010). Myös poronhoitoalueen keski- ja eteläosissa luppo oli vähentynyt ja jäkälää oli enää <30 kg/ha (Mattila & Mikkola, 2009). Lisäruokinta ei ole säästänyt talvilaitumia, mutta sen ja esteaitojen avulla poroja on paimennettu ja voitu pitää kuluneillakin talvilaitumilla. Ruokinnalla on estetty porokatoja, pidetty poromäärät suurina ja vakaina (suurin sallittu poromäärä 203 700 eloporoa), nostettu vasatuottoa ja vasojen syntymä- ja teuraspainoja. Vasateurastukseen (teuraista >75% vasoja) perustuva lihantuotanto (enimmillään 2,5-2,8 milj. kg/vuosi) on lisääntynyt, viime vuosina lisääntyneiden petovahinkojen myötä laskenut. Ruokinta on kesyttänyt edelleen poroa ja lisännyt osin peto-liikennevahinkoja sekä porotautien riskiä lähinnä tarhoissa. Tarhauksella on vähennetty paikoin petovahinkoja. EU-jäsenyyden myötä maksettu eläinperusteinen tuki (28,5 euroa/eloporo, yhteensä 4,4 milj. euroa vuonna 2011) ja myös pinta-alaperusteinen tuki ovat vaikuttaneet suuresti lisäruokintaan perustuvan poronhoidon kannattavuuteen (Meristö ym., 2004). Porojen maastoruokinta on yleensä halvempaa ja hoito luonnonlaitumilla 3-4 kertaa halvempaa kuin tarharuokinta säilörehulla ja teollisilla rehuilla (Nieminen,2010).

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Why supplementary feeding of reindeer in Finland?

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Reindeer husbandry had to base on natural pastures also in Finland. Earlier, only tamed transport reindeer (castrates) were fed with lichens and hay, and but during very severe winters trees (mainly spruce) with arboreal lichens were felled also for feeding other reindeer. Winter feeding of reindeer herds started in the southern and middle parts of the Finnish reindeer herding area in the beginning of the 1960s, and today it is common in almost all herding co-operatives except in Pohjois-Salla. Pen - and field feeding during winter, autumn round-ups and calving period are used, and mainly hay, silage and concentrates are given. Today there are about 1600 pens, and on average 50 reindeer/pen. Pen feeding centralizes into southern part of the reindeer herding area, where in 2007/08 about 77 000 reindeer (>71% of reindeer in that specific area) were on average 90 days in pen feeding. There were almost 8 million pen feeding days. Aging of reindeer owners and damages by predators have increased pen feeding. Numbers of reindeer owners more than 55-year-old have increased in the whole reindeer herding area. This age group owns more than 20% of all reindeer. Field feeding was most common in the middle and northern parts of the reindeer herding area. In 2007/08 about 75 000 reindeer (>60% of the areas' reindeer) were in field feeding. About 18 million kg concentrates and totally over 40 million kg of feed (calculated as dry hay) were used in feeding reindeer. The costs of supplementary feeding were over 28% of the value of slaughter incomes (13 million euros).

In Finland, reindeer are fed mainly because of bad grazing conditions of the winter pastures. The lichen pastures of all boreal forests were in very bad condition already in the middle of 1970s in the middle and southern parts of the reindeer-herding area (mean biomass 85 kg dry weight/ha) (Mattila & Mikkola, 2009). Bad winters and the end of agriculture and small scale farming increased supplementary feeding especially in the herding cooperatives where the possibilities of own feed production were good. Supplementary feeding of reindeer spread into co-operatives of the northern areas, where there were not or only a little arboreal lichen but still >600 kg/ha reindeer lichen on the ground. In 2004, there was on average only 200 kg lichen/ha (Mattila, 2006), and in 2008 also <300 kg lichen/ha in the best lichen pastures (Kumpula *et al*., 2009). Lichens pastures in the large national parks, strict nature reserves and wilderness areas were in bad or very bad condition (lichen <100-300 kg/ha, and in the reach of a reindeer (<2 m) there was <4 kg/ha arboreal lichen (Jaakkola *et al*., 2006; Nieminen, 2010). Also in the middle and southern parts of the reindeer-herding area the amount of arboreal lichen had decreased and biomass of lichen was only <30 kg/ha (Mattila & Mikkola, 2009). Supplementary feeding has not saved pastures but with it and fences reindeer are herded and kept also in very bad winter pastures. Feeding has prevented losses of reindeer and kept numbers of reindeer high and stable (max. 203 700 reindeer), increased the calf production and the birth and slaughter weights of calves. The meat production (max. 2.5-2.8 million kg/year) based on slaughtering of calves (>75% of slaughtered reindeer) has increased but during last years decreased because of loss to predators. Feeding has also tamed reindeer and increased the accidents of reindeer by traffic and losses to predators and there is also the risk of diseases mainly during pen feeding. In some areas, pen feeding has reduced the damages of predators. Support paid for living reindeer during Finnish membership in EU (28.5 euros/ reindeer, totally 4,4 million euros in 2011) and support of cultivated land area have had strong influence on the profitability of reindeer herding based on supplementary feeding (Meristö *et al*., 2004). Field feeding is, however, usually more profitable than pen feeding, and the use of natural pastures is 3-4 times more inexpensive than pen feeding with silage and concentrates (Nieminen, 2010).

References in previous page.

Spillningsinventering som metod för att hitta förändringar i renens användning av betesområdet

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Vindkraft är en lovande källa till förnyelsebar energi, men det finns en oro över negativa effekter på nyckelarter i både boreal skog och fjällområdet. Ekologisk information behövs för att hjälpa företag och myndigheter i planering och bedömning vid etablering av nya vindkraftverk. En genomtänkt planering är fundamental för att undvika och minimera påverkan på renar och vilt samt deras habitat. För att undersöka hur renar påverkas av vindkraftutbyggnad görs spillningsinventeringar med punkt-inventeringsmetoden före, under och efter utbyggnad av två vindkraftparker (Storliden och Jokkmokksliden) i skogsområdet inom Malå sameby (65°13'N, 18°54'E). I den här presentationen kommer jag att visa preliminära resultat från inventeringar gjorda 2009 och 2010, före vindkraftutbyggnaden. Vindkraftparkerna kommer att byggas inom 5 km från varandra, och bestå av 8 respektive 10 verk. Renens användning av betesområdet både på lokal och på regional skala (inom 2 km respektive 20 km från de planerade vindkraftparkerna) inventeras och analyseras.

Linjära regressionsmodeller av spillningstäthet på olika miljöfaktorer utvärderades med syfte att använda dessa för att förutsäga renens användning av hela inventeringsområdet och även i andra oinventerade områden med liknande karaktär. De miljöfaktorer som användes var vegetationstyp, skogens åldersstruktur, höjd, terrängens brutenhet, sluttningens lutning samt riktning och avstånd till vägar och annan infrastruktur som kraftledningar, gruvor och vindkraftverk (används endast i relation till data som samlas in efter att kraftverken är byggda). Preliminära resultat antyder att man behöver använda olika modeller beroende på den spatial autokorrelation i datamaterialet. I det ena området på den lokala skalan visade det sig att det fanns en spatial autokorrelation vilket betyder att man kan använda sig av kriging-interpolation för att förutsäga spillningstätheten över hela området. I det andra området var den spatiala autokorrelation avsevärt mindre och vilket betyder att man kan använda bara miljöfaktorerna för att förutsäga renens användning av hela området. De preliminära resultaten visade också att spillningstätheten ökade i höjdled både på den lokala och på den regionala skalan, likaså när det gäller avstånd till vägar på den lokala skalan men på den regionala skalan minskade antalet spillningar i närheten av vägar. Detta visar att det är viktigt att ha både ett lokalt och regionalt perspektiv när man studerar hur djur förhåller sig till olika typer av miljöfaktorer.

Using pellet-group counts to detect change in reindeer spatial distribution in relation to human development

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Wind power is a promising source of alternative renewable energy but there is concern about adverse effects on key species in both the boreal forest and mountain areas. Ecological information is needed in assessing the impacts and conflicts of proposed wind turbines. Proper planning is critical to avoid and minimize negative habitat impacts. To detect if semi-domesticated reindeer (*Rangifer tarandus tarandus*), are affected by these infrastructural changes, spatial distribution of reindeer faecal pellet groups will be analysed before, during, and after wind power development. In this presentation I will show preliminary results from two consecutive years (2009 and 2010) before wind power development in Malå reindeer herding community in northern Sweden (65°13'N, 18°54'E). In this forest area two wind-power parks (8 and 10 power plants) are built within 5 km distance from each other. Reindeer resource selection at population level was estimated at both the local and regional scale (within 2 and 20 km respectively, from the planned parks).

Linear regressions of density of the pellet groups on habitat variables were evaluated, with the purpose of using them to predict the density of the reindeer habitat use within the whole study area and in other similar areas. The habitat variables used were vegetation type, forest age, altitude, terrain ruggedness, slope, aspect, and distance to roads and power plants (after they are built) or other infrastructure such as power lines and mines. Preliminary results suggest the use of different regression models depending on the spatial autocorrelation in the data set. In one of the study areas at the local scale I found spatial autocorrelation in the data suggesting that kriging interpolation of the pellet group density might be performed. In the other area at the local scale the spatial autocorrelation was very weak suggesting that we can perform a prediction using only the habitat variables. The preliminary results also show that the pellet density increases with altitude at both local and regional scale, and also in proximity to roads at the local scale, while at the regional scale the density decreases in proximity to roads. This confirms the importance of regional scale perspective when studying avoidance behaviour of animals in relation to human constructions and infrastructure.

Oppdaterte trender og scenarier for vinterbeiter i relasjon til reintetthet og klimaendringer

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Vinterbeiter relatert til tetthet av rein
Studier av vegetasjonsendringene på Finnmarksvidda det siste halve århundret dokumenterer betydelig økning i biomassen av trær, busker, karplanter og mose gjennom hele perioden. Bare biomassen av lav har gått betydelig ned i det meste av perioden, men har økt noe etter årtusenskiftet. Vegetasjonstyper dominert av blåbær, smyle og skrubbær er tredoblet i løpet av femti år, mens lavdominerte heier og skoger som er foretrukket som reinbeite, er redusert med 80%. Samtidig har det vært en økning i utbredelsen av bjørkeskog med mer enn 100% på Finnmarksvidda. En hypotese foreslår en forklaring på dette ved at de tette reinlavmattene som dominerte vinter-, vår- og høstbeiteområdene på Finnmarksvidda fram til 1970-tallet agerte som en "barriere" mot at frø fra bjørk og andre tre- og buskslag (dvergbjørk, vier, einer og furu) fikk lov til å spire og vokse opp. Den økende reinbestanden på 1970-80-tallet og illegal bruk av de ytre deler av vidda om sommeren førte til sterk reduksjon av lavmattene og dermed opphørte denne "barrierevirkningen" og dermed har bjørk og andre tre- og buskslag fått anledning til å vokse opp til kratt og skog. Vi påviste en signifikant og positiv sammenheng mellom økningen av reintall og økning av skogsarealene, og dermed må forannevnte hypotese anses som gyldig. Den brå nedgangen i lavdominerte områder og den påfølgende økningen av skogsarealet synes derfor å være en direkte følge av den intensive beitingen av en økende reinstamme, men klimaendring (økt sommernedbør), bjørkemålerangrep og langtransportert luftforurensing (bl.a. nitrogen) virker også inn.

Vinterbeiter relatert til klimaendringer
De arktiske områdene gjennomgår betydelige endringer når det gjelder klima. Spesielt vinterstid så forventer man større frekvens av ekstreme episoder som for eksempel vinterregn, men slike klimaeffekter har ikke fått samme oppmerksomhet som varmere sommerklima og lengre barmarks-sesonger. En kraftig og kort mildværsperiode med temperaturer på opp til +7 ^{o}C i Narvik-Torneträsk-Abisko-området rundt årsskiftet 2007-08 og påfølgende barfrost førte til en alvorlig krise for krekling-dominert vegetasjon. Vi observerte påfølgende sommer betydelige frostskader på bærlyngvegetasjonen, og særlig på krekling. Skadene var så omfattende at de var synlige på satellittbilder. Mildværsperioden i desember-januar gjorde at snøen smeltet vekk fra flere hundre kvadratkilometer. Det tykke snødekket fungerer som isolasjon for planter, men etter en slik mildværsperiode mangler de isolasjonen og får virkelig føle den fulle effekten av ustabilt vinterklima. Analyser av de skadde områdene viste 87% mindre sommertilvekst på kreklingplantene enn i uskadde områder ved siden av. Normaliserte vegetasjonsindekser (NDVI) ekstrahert fra satellittbilder påviste en reduksjon i biomasse og fotosynteseaktivitet på 26% i et område på 1424 km^2 i 2008, sammenlignet med årene 2000-2007..

Ekstra interessant er denne observasjonen siden vi fant tilsvarende effekter i et samtidig pågående simuleringseksperiment ved den naturvitenskaplige stasjonen i Abisko i Nord-Sverige. Her fant vi stor frekvens av døde planter (21 ganger flere tilfeller i forhold til ikke-manipulerte felter) og redusert vekst (opptil 47% redusert vekst) påfølgende sommer. Våre studier i landskapet og i det simulerte eksperimentet viser at økosystemene står under hardt press når vinterklimaet blir mer ustabilt som følge av klimaendringer og død av krekling og blåbær kan føre til mer grasdominerte vegetasjonstyper som vil føre til at reinlav blir konkurrert bort. Slike varmeperioder på vinteren er ikke noe nytt fenomen, men større hyppighet som følge av klimaendringer kan komme til å forskyve balansen i økosystemene og dermed endrede forhold for reindriften.

Kilder etter den engelske versjonen.

Recent trends and scenarios for winter pastures in relation to reindeer density and climate change

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Winter pastures related to reindeer density

Our study focuses on vegetation changes in the mountain birch *(Betula pubescens* ssp. *czerepanovii)* forests and the lichen dominated heaths of Finnmarksvidda, northern Norway. The vegetation here was predominantly covered by lichen (*Cladonia* spp. and *Cetraria* spp.) and dwarf shrub vegetation before 1970. A rapid and large increase in the reindeer population during the period 1970-1990 reduced the lichen biomass significantly. In order to reveal the dynamics of vegetation change, we used vegetation maps based on aerial photographs and satellite imagery from 7 years in combination ground estimation data of biomass in the period for the period 1957–2006. The main vegetation change was that the forested areas in Finnmarksvidda doubled in the period 1957–2006. Only the lichen biomass has been significantly reduced in the period 1957 to 2000, with a subsequent and rapid increase of lichen biomass in the most utilized areas in the period 2000 to 2006 due to reduced reindeer population in the period 1996-2004. The results presented in this study show significant and positive relationships between measured tree biomass and the increase in reindeer population in the period 1957–2006, while the opposite was due for the lichen biomass. The hypothesis concerning the removal of the ‘‘lichen barrier effect’’ by heavy reindeer grazing which leads to increased success for birch seeds to germinate and sprout is therefore considered to be valid. However, also, climate change effects like increased precipitation, moth attacks, freezing and thawing events during winter and long-transported air pollution (e.g. nitrogen) may also have reinforced the change and transition of vegetation types.

Climate change

The Arctic is experiencing considerable change in climate, particularly in winter, and a greater frequency of extreme climatic events is expected. However, the impacts of winter climate change and extreme events have received far less attention than the impacts of season-long summer warming. Here we report findings from observations following a natural event and from experimental studies to show that short (<10 days) extreme winter warming events can cause major damage to sub-arctic plant communities at landscape scales. In the landscape observations, impacts were assessed following an extreme winter warming event that occurred in December 2007 in the Narvik-Torneträsk-Abisko-area in northern Fennoscandia. During this event, temperatures rose up to 7 ^{o}C resulting in loss of snow cover and exposure of vegetation to firstly warm and then returning cold temperatures. In the following summer, extensive areas of damaged dwarf shrub vegetation could be observed. Ground observations showed damaged areas to have a 16 times greater frequency of dead shoots of the dominant shrub *Empetrum hermaphroditum*, resulting in 87% less summer growth compared to adjacent undamaged areas. The landscape scale extent of this damage was confirmed by satellite-derived Normalized Differential Vegetation Index (NDVI) values that showed a considerable 26% reduction (comparing July 2007 with July 2008 values) over an area of 1424 km^2. This reduction indicates a significant decline in either leaf area or photosynthetic capacity or efficiency at the landscape scale.

Similar damage were observed in a field manipulation experiment using heating lamps and soil warming cables to simulate such extreme events in sub-Arctic heathland over two winters. Here, an up to 21 times greater frequency of dead shoots and 47% less shoot growth *of E. hermaphroditum* was observed in plots exposed to simulated winter warming events compared to un-manipulated controls. Damage to *E. hermaphroditum* and other dwarf shrubs like *Vaccinium myrtillus* may change the former dwarf shrub-lichen dominated vegetation to grass-dominated vegetation.

Synthesis. These combined landscape observations and experimental findings provide compelling evidence that winter warming events can cause considerable damage to sub-arctic vegetation. With increasing winter temperatures predicted, any increase in such damage may have major consequences for productivity and diversity of these sub-arctic ecosystems, in contrast to the greening of parts of the Arctic currently attributed to summer warming.

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Sammenheng mellom varierende reintetthet, kvalitet på sommerbeite og viltpopulasjoner

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Kvaliteten på reinens sommerbeiter, grønnbeitene, er i stor grad avhengig av hvilke planter som dominerer i fjellbeitene, og over store deler av Nord-Norge er det krekling og andre dvergbusker som dominerer, planter med begrenset næringsverdi og lav produksjon. Disse plantene dominerer selv der smakelige gress og urter har gode vekstforhold, dvs i de mest produktive fjellbeitene. Ved stort beitepress er det imidlertid forventet at slike dvergbusker gir tapt for gress, en endring som kan være gunstig for beitenes produksjon.
Basert på undersøkelser i 20 sommerbeitedistrikter ser vi at reinsdyr har stor påvirking på de grønne beitene i Nord-Norge. Men, til tross for stort beitepress av rein er dvergbuskene like framtredende, og i kontrast til forventningene, er det der beitepresset er lavere at beitene har mer gress og urter.
Reinen endrer også beitene for annet vilt. Vierkratt forkommer i større grad der beitepresset av rein er mindre, og her forekommer også hyppigere spor etter rype. Spor etter smågnagere forekommer derimot typisk i de habitatene der vi også finner mye spor etter rein.
Vi konkluderer med at stort beitepress ikke er gunstig for produksjonen i reinens sommerbeiter i Nord-Norge. Der beitepresset er lavere er det større innslag av produktive og mer næringsrike planter mens planter med begrenset næringsverdi og lav produksjon uansett holder stand. Basert på våre funn mener vi at beitenes produksjon er regulert av en kombinasjon av beitepress og av dominerende plantetype.

Relationship between reindeer density, quality of summer pasture and populations of game

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The quality of reindeer summer pastures, the green pastures, is to a large extent dependent on which plants that dominate the pastures. Crowberry and other dwarf shrubs, plants with limited nutritious value and low productivity, dominate pastures over large parts of northern Norway. These plants dominate even where grasses and forbs have good conditions for growth, which is within the more productive alpine pastures. Such dwarf shrub dominance is however expected to surrender to grass domination under increased grazing pressure, a change that can be beneficial for the productivity of the pastures.
Based on a survey within 20 summer pasture districts we find that reindeer have large impact on their summer pastures in northern Norway. However, despite a large grazing pressure dwarf shrubs are still dominating the pastures, and in contrast to expectations, it is where grazing pressure is lower that pasture quality is improved with more grasses and forbs.
Reindeer also change the pastures to game animals. Willow thickets occur more frequently where reindeer densities are lower, along with more frequent traces of ptarmigan occurrence. Traces of small rodents are however co-occurring in the habitats where we also find traces of reindeer.
We conclude that larger grazing pressure is unfavourable for the productivity of reindeer summer pastures in northern Norway. Alpine pastures hosting lower reindeer densities have higher content of productive and nutritious plants, whereas plants of limited nutritious quality and low productivity attain their dominance. Based on our findings we argue that the productivity of reindeer summer pastures in northern Norway is regulated by a combination of grazing pressure and plant type domination.

Rein, klima og planteproduksjon

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Klimaet i Arktis er i endring. Vintrene har blitt mildere og mer nedbørsrike. Samtidig er det dokumentert at våren kommer tidligere og at det blir grønnere i Arktis. Primært har det vært fokusert på hvordan milde vintre og økt nedbør med påfølgende låsing av beiter påvirker klauvdyr. Hos rein/caribou (heretter kalt rein; *Rangifer tarandus*) er det dokumentert at vanskelige beiteforhold vinterstid kombinert med høye tettheter kan ha negative effekter på påfølgende overlevelse og kalveproduksjon. I den senere tid har det vært poengtert at en tidligere vår kan være uheldig fordi enkelte arter ikke er i stand til å følge en slik fenologisk endring. Dette synes blant annet å være tilfelle for rein på Grønland hvor en tidligere vår har vært assosiert med en lavere andel kalv per simle. Vi har vært interessert i å undersøke hvordan disse forholdene påvirker reindriften. For hvert distrikt/siida innen reindriften finnes det informasjon om bl. a. reintall og slaktevekt fordelt på kjønn og alder. I tillegg finnes det data om antall kalv som merkes og tapes. For å få en oversikt over når våren kommer har vi brukt satellittdata fra MODIS. Fra Terrasatellitten finnes det data fra og med høsten 1999 og vi har tatt utgangspunkt i disse årene og fokusert på distriktene i Finnmark hvor det finnes fullstendige tidsserier. Det har vært stor variasjon i vårens ankomst i studieperioden, og i motsetning til hva som er funnet tidligere, ser det ikke ut til at reinen har problemer med å følge disse endringene. En tidlig vår er gunstig for både kalvevekter og kalveproduksjon. I tillegg ser en tidlig vår ut til å redusere tapet voldt av rovdyr. De negative effektene av mildere og våtere vinterklima synes derfor å kunne motvirkes av en tidligere vår.

Reindeer, climate and plant production

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The climate in Arctic is currently changing. Winters are becoming milder and wetter, the onset of spring is earlier, and remotesensing has shown that there is an ongoing greening of the arctic tundra as a result. The primary focus regarding impact of climate change on ungulates has been directed towards the understanding of how mild and wet winters impact their demography and life history. For reindeer/caribou (herafter reindeer; *Rangifer tarandus*) is has been shown that unfavourable climatic conditions that result in icing might, in combination with high densities, have negative impact on subsequent survival and reproduction. It has recently been argued that an earlier onset of spring might also negatively impact wildlife because some species are unable to track the fenological advancement resulting from a warmer climate. This seems to be the case for reindeer at Greenland where an earlier onset of spring is associated with a lower calf-female ratio. Our aim has been to explore how these circumstances might affect the reindeer husbandry. For each reindeer district and siida information on population size and slaughter body mass per sex and age class is available from the reindeer husbandry administration. Additionally there is information regarding number of calves marked and animals lost. To gather information about when the spring greening occurs we used satellite remote sensing data from MODIS. The Terra satellite has delivered data since the fall 1999 and we have focused on this time period and the districts with complete time series. The onset of spring varied with more than a month over the study period, and contrary to what have been documented earlier, there was no indication that reindeer was unable to track cope with these changes. An early onset of spring was associated with more calves per female and heavier calves. Additionally, an early onset of spring reduced the loss of animals to predators. Our results suggest that the negative effects of a milder and wetter winter climate might be offset by an earlier onset of spring.

Adaptive forvaltningsregimer i reindrifta: hvilken betydning har geografiske og sosioøkonomiske forskjeller?

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Adaptive forvaltningsregimer, som er effektive og legitime, krever veloverveide avveiinger mellom behovet for standardisering og fleksible tilpasninger. Store geografiske, økonomiske og sosiale forskjeller kan gi ulike preferanser og insentiver for å følge fellesløsninger, og gjøre det mer krevende å finne tiltak som alle kan enes om. Målsetningen med dette studiet er å identifisere de viktigste geografiske og sosioøkonomiske forskjellene i reindrifta i Finnmark.

Studiet var i utgangpunktet designet for å finne årsakene til de store romlige ulikhetene i reintall og produktivitet mellom nabodistrikter på sommerbeite i Finnmark (høy vs lav tetthetsdistrikter). Parvise sammenligninger mellom distrikter som har sammenlignbart naturgrunnlag, gir bedre muligheter for å avdekke sosiale forskjeller mellom distriktene, men ulikheter mellom Karasjok, og ytre og indre distrikter i Vest-Finnmark ble også undersøkt.

Totalt 77 reineiere deltok i intervjuundersøkelsen i de 10 distriktsparene (20 distrikter). I alle distriktene ble distriktsformann, og lederen for de største og de minste driftsenhetene forespurt om å delta i studiet. Dersom noen av de største eller minste driftsenhetslederne var negative til å delta, gikk vi videre på den rangerte lista. I distrikter med mer enn 8 enheter delte vi reineiere inn etter siida, kjønn og alder, og valgte tilfeldig innen de kategoriene som var dårligst representert i utvalget (både driftsenhetsledere og husholdsmedlemmer). Slike komparative undersøkelsene krever en variabel orientert tilnærming som tillater sammenlikning, samtidig som at de åpner for dialog om ulike sosiale praksiser.

Intervjuundersøkelsen var semistrukturert, der vi startet hvert tema med åpne spørsmål for diskusjon, mens de predefinerte spørsmålene ble stilt på et senere stadium i intervjuet. Svarene ble som regel kodet i 3 ordinale nivåer, og ordinal regresjon med distriktspar som tilfeldig variabel ble brukt i de fleste analyser. Hovedforskjellen mellom høy- og lavtetthetsdistrikter var tilgang til arbeidskraft og holdninger til forvaltningstiltak for å redusere antall reineiere. Høytetthetsdistrikter har flere som kan bidra i arbeidsintensive perioder og større sikkerhet for avløsning hvis nødvendig. I tillegg oppgir høytetthetsdistriktene større begrensninger på vår, høst og sommerbeite enn lavtetthetsdistriktene. Ytterdistriktene mener mangel på arbeidskraft er en utfordring for dem, samt begrensinger på høst - og vårbeite. Mens de aller fleste oppgir vinterbeitene som flaskehalsen i deres drift, oppfatter de i Karasjok tilgang til vinterbeitene som et større problem enn i Vest-Finnmark. Heller ikke innad i distriktene var det store forskjeller mellom reineierne. De største reineierne var mer fornøyde med økonomiske subsidier, spesielt omleggingene i 2003 til produksjonspremie. De fleste slutter seg til et produksjonsfokus, men de mindre reineierne peker på at produksjonspremien er urettferdig for de små, og at det legges for mye vekt på bulkproduksjon i stedet for kvalitet. Samtidig har de største reineierne generelt lavere lønnsinntekter enn de mindre reineierne.

Vi fant få tydelige forskjeller i holdninger til produksjon, forvaltning, risikotilpasning og tillit. De fleste fremhever produksjon som viktig for deres drift, de mener høy vekt er viktig for å unngå tap, og de ønsker ikke ytterligere overføring av ansvar til reineierne eller samiske organer for reintallsjusteringene. Det etterlyses mer klare rammebetingelser fra et uavhengig og upartisk organ for at økonomiske virkemidler og medforvaltning på sikt skal kunne fungere. Resultatene kan tyde på at reindriftsforvaltninga er avhengig av å balansere behovet for ”prosedyrisk rettferdighet” med fleksible tilpasning for å bygge tillit over tid. Videre analyser på siida nivå er nødvendig for å forstå forskjellene i driftspraksiser i Finnmark, og for å bygge et velfungerende og adaptivt forvaltningsregime.

Adaptive regimes: what is the importance of geographic and socioeconomic conditions?

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Adaptive resource regimes need to find the appropriate balance between flexible adaptations and consistency to achieve effectiveness and legitimacy. Large geographic and socioeconomic differences may produce different preferences and incentives for collective action, which makes it more demanding to find common solutions that are fair and agreed upon by all resource users. The aim of the present study is to identify the most important geographical and socioeconomic differences among reindeer owners in Finnmark.

The study was originally designed to understand the reasons behind the spatial differences in reindeer numbers and productivity between neighbouring districts on summer pastures in Finnmark (high and low density districts). Pairwise comparisons between districts allow controlling for biophysical factors to detect contrasts pertaining to social factors, but differences between Karasjok, inner - and outer districts in West-Finnmark were also analyzed.

In total 77 reindeer owners in 10 district pairs (20 districts) participated in the interview inquiry. In all districts, the district leader and the leaders of the largest and the smallest herding units were asked to participate. If reindeer herders did not want to participate in the study, we moved to the next herder on the ranked lists. In districts with more than eight units, we assigned reindeer herders to categories according to kinship groups (siida), sex and age. We targeted the categories that were not yet well represented by the previous selections and randomly selected from these. Such an inquiry requires a variable-oriented approach that balances comparability with an open dialogue about reindeer herding practices.

The interview inquiry was semistructured where each thematic field started with open-ended questions to stimulate dialogue. Predefined questions were introduced later to ensure comparability. The answers were coded in three ordinal categories, and ordinal regression with district pairs as a random factor was generally used for analyses. The main difference between low and high density districts was access to labour and attitudes towards reducing number of reindeer owners. Reindeer herders in high density districts could more easily be replaced by trusted workers and have more access to labour in work incentives periods. They also report higher constraints on spring, autumn and summer pastures than low density districts. The outer districts in West-Finnmark also find access to labour poor, and claim higher contraints on spring - and autumn pastures. Most of the reindeer owners find the winter pastures as bottlenecks for their production but reindeer owners in Karasjok find access to winter pastures as a larger problem than the other districts. There were not large differences within districts. The largest unit leaders were more satisfied with the economic subsidies than others. While most agree on a production focus, the smaller reindeer owners argue that the system is unfair for the small herding units, and that too much emphasis is made on bulk production rather than meat quality. On the other hand, the large herding units had less wage income than smaller herding units.

There were not clear geographic or socioeconomic differences in attitudes towards production, management, risk adaptations and trust. Most emphasize production, they assert that weight is important for losses, and they do not want transfer of further responsibilities to districts or Sami institutions. They call for more procedural justice and improved terms by an impartial and independent institution, for economic incentives and co-management to function as intended. The results indicate that there is a need to combine procedural justice with flexible adaptations to build trust over time. Further analyzes on siida level is necessary to understand contrast in herding practices in Finnmark and to build a well functioning adaptive regime.

Haastattelututkimus porojen jalostusvalinnasta

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Porojen jalostusvalinta on työkalu porotalouden taloudellisen tuloksen kehittämiseen. Jalostusvalinnan tehokkuuden tarkastelua varten tutkimme poronhoitajien käyttämät siitoseläinten valintakriteerit haastattelemalla poroisännät. Poroisännillä on pitkä kokemus ja vastuu paliskunnan käytänteistä, joten heidän tietojensa perusteella saadaan kattava kuva koko poronhoitoalueesta.

Kevään 2010 aikana yksi haastattelija sai haastateltua 43 Suomen 56 poroisännästä, vastausprosentti oli siten 77. Haastatteluissa käytettiin puolistrukturoitua metodia eli kysely eteni vastaajille etukäteen lähetetyn lomakkeen mukaisesti, täydennettynä tilanteenmukaisilla lisäkysymyksillä. Haastatteluissa kartoitettiin haastateltavien taustatietoja, poronhoitomenetelmiä, paliskunnan ympäristötekijöitä sekä porojen jalostusvalintaan vaikuttavia seikkoja.

Laajalla poronhoitoalueella teurasporojen painoihin ja selviytymiseen vaikuttavia tekijöitä on paljon. Petojen määrä, vaatimen hoitokyky, siitosporojen valinta ja paliskunnan laiduntilanne koetaan tärkeimpinä yksittäisinä lihantuotantoon vaikuttavina tekijöinä. Myös sää, ruokinta ja hirvaiden riittävä määrä ovat tärkeitä tekijöitä. Vaatimien ikärakenne, muu maankäyttö, loiset ja sairaudet sekä kesäaikaisen tokan koko olivat hyvin merkittäviä joissakin paliskunnissa.

Siitosporojen valinnassa vasoja jätetään siitokseen porolukusääntelyn sallima määrä, normaalitilanteessa paliskunnan porolukua ei lisätä. Jalostusvalinnan intensiteetti on korkea, mikä lisää sen tehokkuutta. Poronomistajat itse valitsevat siitokseen jätettävät eläimet, kukin omien kriteeriensä mukaan. Poroisäntien käyttämät valintakriteerit eivät juuri eroa paliskunnan muiden osakkaiden käyttämistä valintakriteereistä.
Tärkeimmät yksittäiset siitosvalintaan vaikuttavat tekijät ovat vasan koko, terveys, elinvoima, lihaksikkuus, emä sekä emän hoitokyky. Kohtalaisen tärkeitä ovat karvan pituus ja laatu, sarvien kärkien terävyys, haarasarvisuus sekä sarvien nahattomuus. Sen sijaan vasan värillä, luonteella, sarven juuren paksuudella tai ajokkaaksi sopivuudella ei ole suurta painoarvoa siitoseläinten valinnassa. Suurissa paliskunnissa vasan sarviin ja kokoon kiinnitetään enemmän huomiota. Ulkomuoto-ominaisuudet ovat tärkeitä, koska eläimistä ei ole yleensä sukulaisuus- tai tuotostietoja. Sukulaisista vain emä voidaan tunnistaa ja vain sen suvulla on merkitystä, isät tunnetaan vain harvoin.
Poronjalostuksen suuri haaste on yksilöiden merkintä ja tunnistaminen. Yli puolet poroisännistä merkitsee kaikki siitosporonsa yksilöllisesti ja noin 75% isännistä tunnistaa suurimman osan tai kaikki poroistaan yksilöinä. Noin 40% pitää yksilöllisesti kirjaa poroistaan sekä tunnistaa porojensa emistä ainakin puolet.

Sukupolvien kierto vaikuttaa valinnan tehoon. Siitosvaatimen maksimi-ikä on 10 – 12 vuotta, kun taas hirvaat poistetaan 4 – 7 -vuotiaina. Sukupolvien kierrossa on eroja, etelässä hirvaat poistetaan yleensä nuorempina kuin pohjoisessa. Hirvaan haaremin koko kasvaa sen iän myötä ja porojen kokoaminen vaikeutuu, jos hirvaskanta on liian nuori. Tällä on merkitystä työn määrän kannalta, porot on helpompi koota suuremmista parttioista. Mielipiteet nuorten vaatimien vasomisesta ja vuonelojen vasojen jättämisestä siitokseen vaihtelevat. Toisaalta ei haluta vaatimen vasovan liian nuorena, koska se heikentää vaatimen kuntoa; toisaalta lisäruokinta auttaa vaatimen kuntoutumisessa. Sukusiitoksen merkitys tiedetään hyvin ja sitä estetään karsimalla hirvaat siitoksesta riittävän ajoissa sekä vaihtamalla siitoseläimiä paliskuntien sisällä ja välillä.

Vasahävikki on vaikuttanut alueellisesti siitosvalintaan: alueilla, joilla on paljon petoja, ei enää ole riittävästi vasoja siitosvalintaa varten vaan pahimmillaan kaikki naarasvasat pitää jättää uudistukseen ja jopa tuoda vasoja muista paliskunnista poroluvun ylläpitämiseksi. Siitoseläinten valinta kiinnostaa yleensä poroisäntiä hyvin paljon ja se koetaan tärkeänä sekä eläinten laadun että lihantuotannon kannalta. Keskittyminen emiin valinnassa tuli haastatteluissa esiin vahvasti.

Survey on management and selection decisions among reindeer herders

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Selection of breeding animals is a tool to improve the revenues in reindeer production because selection results in heavier slaughter carcasses and better survival of the reindeer calves. Information of selection criteria in practice is missing, but would be important when assessing the possibilities of more efficient selection. We interviewed the managers of reindeer herding cooperatives about management and selection decisions. The managers are responsible for the practical activities in their cooperatives; their knowledge combined in this census study forms a comprehensive picture of practices in the whole Finnish reindeer herding area.

The methodology applied in the survey was a semi-structured interview. The questionnaire, which was mailed to the respondents before the interview, included open questions as well. One person did all the interviews by phone during the spring 2010. Of the 56 cooperative managers, 43 were interviewed; thus the response rate was 77%.

Factors affecting calf survival and carcass weights differ in the vast reindeer herding area. The main factors are number of predators, dam's maternal care, selection of animals for breeding, and pasture conditions. Therefore the weather during the summer season, additional feeding of dams and sufficient number of breeding males are of importance. Regionally prominent factors were age distribution of females, land use for other than reindeer production, parasites and diseases, and the size of summer flock.

Herders select the breeding animals in the round-ups in the autumns. The managers of cooperatives use in many cases similar selection criteria as the other reindeer herders in the same cooperative. The most important selection criteria are body size, health and vigour, muscularity, dam or dam line and dam's maternal care. Of moderate importance are characteristics like hair length, hair quality and such antler traits as hard and sharp tips, branched antlers and early shedding of antler velvet. However, traits as calf temperament, thick antler bases, hair colour, and suitability for sledge pulling or racing, have only small effect on selection. In large cooperatives antlers and calf size are more important than in the small cooperatives.

The easily observable exterior is prominent in selection decisions, because normally there are neither production records nor pedigree information available. Only dams can be identified, whereas sires are known very rarely; therefore maternal lines are more important in selection than paternal lines.

Generation interval affects the selection efficiency. The breeding females are culled at the age of 10 – 12 years, while the males' life span is 4 – 7 years. Generation interval in males is shorter in southern parts of the reindeer herding area compared to the northernmost co-operatives. Old males have bigger harems compared to the young males; and gathering of reindeer is easier when they are in bigger flocks. However, breeding males need to be culled early enough to avoid inbreeding. Exchange of breeding animals within and between co-operatives is common method to avoid inbreeding.

Early calving is avoided in large cooperatives, because young female's own growth is slowed down when it has to raise a calf. Such a draw-back can be compensated by feeding. Appreciation of young females' calves as breeding animals varies among the respondents.

The challenge in reindeer breeding is identification and use of collars or ear tags. More than half of the cooperative managers would mark their breeding animals and approximately 75% recognises majority or all of their animals individually. About 40% of respondents perform bookkeeping of their animals and identify at least half of their reindeer's dams. Importance of the dams in breeding selection is clear in many cooperatives.

At present in many co-operatives predation weakens the effect of breeding selection: in the south-east most of survived female calves are needed for replacements. In the worst areas herders need to import calves and yet the total number of reindeer is falling. Regardless, reindeer herders find the breeding selection very interesting know its importance in improving the quality of breeding animals and meat production.

Pastoral risikohåndtering – viktigheten av samarbeid

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Nomadiske pastorlister som lever i et miljø karakterisert av miljømessig uforutsigbarhet er nødt til å håndtere produksjonsrisiko for å maksimere langtids overlevelse. Flokkbygging er en omdiskutert strategi siden størrelsen på flokken kan virke som en buffer mot å falle under en minimumsgrense av antall dyr i perioder når miljømessige katastrofer inntreffer. Arbeidskraft har blitt antatt å være en viktig underliggende mekanisme for flokkbygging selv om de studiene som har kvantifisert forholdet mellom arbeidskraft og produksjon har vært preget av motstridende resultater.

Resultatene rapportert her er basert på tre studier fra den samiske reindriften i Norge (Næss m.fl., 2009, *Human Ecology*; 2010, *Evolution and Human Behavior*; Næss & Bårdsen, 2010, *Human Ecology*) hvor det ble vist at: (1) Flokkbygging er en risikoreduserende strategi siden store reinflokker gjør det bedre enn mindre over tid. (2) Tidligere motstridende resultater knyttet til forholdet mellom arbeidskraft og produksjon kan bli forklart av at tidligere studier har hatt et manglende fokus på samarbeid. Fra et teoretisk ståsted kan man argumentere for at pastoral arbeidskraft er karakterisert av en skalaavhengighet siden forholdet mellom kostnader og fordeler ved arbeidsinvestering kan være forskjellig på forskjellige nivåer av sosial organisering, og hvor det å samarbeide med andre hushold kan være den minst kostbare strategien. Skala-avhengighet ble vist å være til stede i reindriften siden antallet mulige samarbeidende driftsenheter og slektskapsrelasjoner hadde en positiv effekt på: (i) individuelle driftsenheters flokkstørrelse, (ii) simletetthet og (iii) kalvenes kroppsmasse. Disse resultatene indikerer at fremtidige studier burde undersøke hvordan samarbeid kan påvirke pastoral produksjon, og enda viktigere hvordan samarbeid kan være en viktig mekanisme for risikohåndtering i uforutsigbare miljøer. Dersom flokkbygging er en viktig risikoreduserende strategi hvis suksess er delvis avhengig av samarbeid på tvers av driftsenheter så har dette viktige implikasjoner i forhold til både den generelle forståelsen av pastorale systemer og hvordan disse bør forvaltes. I de fleste områdene hvor det drives reindrift i dag predikerer de fleste klimamodellene at fremtidige vinterforhold vil bli mer uforutsigbare. Samarbeid i forhold til risikoreduksjon vil dermed kunne bli enda viktigere i fremtiden enn det som er dokumentert i tidligere studier.

Pastoral risk management – the importance of cooperation

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An important problem facing nomadic pastoralist inhabiting unpredictable environments is the ability to manage production risk in order to maximise long-term household survival. Herd maximization is one widely discussed risk reducing strategy as herd size may act as buffer against falling below a subsistence threshold during occasional environmental catastrophes. Labour investment have been argued to be an important prerequisite for accumulating herds, although the few studies that have quantified this relationship have found contradictory results.

The results reported here are based on three studies from the Sami reindeer husbandry in Norway (Næss et al., 2009, *Human Ecology*; 2010, *Evolution and Human Behavior*; Næss & Bårdsen, 2010, *Human Ecology*) where it has been shown that: (1) Herd accumulation is a risk reducing strategy since larger reindeer herds perform better than smaller ones over time. (2) Earlier contradictory results pertaining to the relationship between pastoral labour and production can be explained by a within-household bias, neglecting possible between household cooperative labour investments. From a theoretical point of view, it is possible that pastoral labour is characterized by scale dependency, consisting of changes in the cost-benefit relationship and where cooperative labour investment may be a least-cost strategy. Scale dependency of pastoral labour was shown to be present in the reindeer husbandry as the number of possible cooperating husbandry units and genealogical relationship had a positive effect on: (i) individual husbandry units' herd size; (ii) density of female reindeer; and (iii) offspring body mass. These results suggest that future studies have to investigate possible cooperative labour related effects on pastoral production, and more importantly that cooperative labour investment is an important mechanism for buffering risk in unpredictable environments. Moreover, if herd maximization is an important risk reducing strategy facilitated by cooperative labour investment, this has important implications not only for our understanding of pastoral systems in general, but also in relation to how these systems should be managed. More to the point, for most of the areas inhabited by reindeer herders almost all climate models predict future winter climatic conditions to be more unpredictable than present day, and cooperative risk reducing strategies may thus become increasingly important for the reindeer husbandry.

Hvordan påvirker klima og høsting reindriften

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Et viktig og til dels konfliktfylt tema i forskning på pastoralisme, er hvordan beitelandets produktivitet påvirkes av tetthet av beitedyr og klima. På den ene siden hevdes det at fellesbeiter gir økt konkurranse om beiteressursene. Dette fører til lavt slakteuttak, høy tetthet av beitedyr, lav kondisjon på dyra, og økt sårbarhet i perioder med vanskelige klimaforhold. På den andre siden hevdes det at mange beitedyr er en forsikring mot et marginalt og variabelt miljø, og at høye tettheter i liten grad forringer beiteressursene. Det første synet argumenterer for at systemet er regulert ovenfra-og-ned gjennom høsting, mens det andre synet argumenterer for at systemet er regulert nedenfra-og-opp gjennom klima. De siste ti årene har vi undersøkt dette temaet i reindriften i Norge. Vi har analysert reindriftens egne databaser, vi har undersøkt beiteressursene ved hjelp av fjernmåling, og vi har studert tap, produksjon og vekter på flokknivå gjennom observasjonelle og eksperimentelle studier. Vi finner evidens for begge de fremherskende synene på pastoralisme, og viser at reguleringen av systemet skifter mellom rådende klimaregimer. I områder med gunstige klimatiske betingelser, finner man klare sammenhenger mellom reintall, beiteressurser, kalvevekter og slakteuttak. Høye reintall påvirker beitene, gir lave vekter og økt sårbarhet for dårlige vintre. I disse områdene er systemet regulert ovenfra-og-ned gjennom slakteuttak, siden et høyt slakteuttak stabiliserer reintallet, fører til økte vekter, reduserer sårbarhet, og gir økt plantebiomasse. Denne reguleringen reverseres i områder med ugunstige klimatiske betingelser. I disse områdene er reintallet og produksjonen generelt lav. Vektene er høye og dyrene er mer robuste i møte med dårlige vintre. Reintallet er positivt relatert til planteproduksjon, og slakteuttak påvirker i liten grad systemet. Vi foreslår derfor at det rådende klimaregimet bestemmer hvordan reindriften er regulert. Under gunstige klimabetingelser er systemet regulert ovenfra-og-ned ved at intensiv høsting er nødvendig for å kontrollere reintallet. Under dårlige klimabetingelser er systemet regulert nedenfra-og-opp ved at planteproduksjon bestemmer reintallet. Vi hevder at denne endringen i regulering er knyttet til reinens individuelle tilpasning til et variabelt miljø. En slik tilpasning innebærer høy bestandsvekst og høy sårbarhet under gunstige klimabetingelser versus lav bestandsvekst og lav sårbarhet under ugunstige klimabetingelser.

How is the reindeer husbandry regulated by climate and harvesting?

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How pasture productivity is affected by stocking density and climate is an important and controversial topic in pastoralism research. On one side, it is argued that common pastures will enhance the competition among pastoralists. This will result in reduced harvesting, high stocking density, low animal body condition and increased vulnerability to periods with harsh environmental conditions. On the other side, it is argued that a large herd works as an insurance against episodes of harsh environmental conditions, and that a high stocking density does not reduce the pasture quality. According to the first view, the system is top-down regulated by harvesting. According to the second view, the system is bottom-up regulated by climate. For the last ten years, we have investigated this topic with respect to reindeer husbandry in Norway. Studies include analyses of databases from the reindeer husbandry administration, investigation of pastures though remote sensing, and observational and experimental studies on body mass, calf production and calf losses in individual herds. We find support for both views on pastoralism, and show that the regulation of the system depends on prevailing climatic conditions. Areas with favorable conditions are characterized by close relationships between reindeer densities, pasture quality, calf body mass and harvest rates. High stocking density affects the pastures, and is associated with low body mass and increased vulnerability to adverse winter climate. In these areas, the system is top-down regulated by harvesting, since a high harvest rate stabilizes the reindeer density, increases the body mass, reduces the vulnerability and increases the plant biomass on the pastures. This regulation is reversed in areas with unfavorable climatic conditions. In these areas, stocking densities and productivity is generally low. Body mass is high and the animals are robust to poor winter conditions. Reindeer number is positively related to primary production, and harvesting does not seem to regulate the system. We propose that prevailing climatic conditions determines the regulation of reindeer husbandry in Norway. Under benign conditions, the system is top-down regulated since intensive harvesting seems to be necessary to control the reindeer number. Under malign conditions, the system is bottom-up regulated, since plant productivity seems to determine the reindeer number. We argue that this change in regulation is linked to the adaptation of individual reindeer to a variable environment. This adaptation involve high population growth rate and high vulnerability under prevailing benign conditions versus low population growth rate and low vulnerability under prevailing malign conditions.

Kan reinsimler tilpasse seg klimaendringer?

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Økologer har lenge studert hvordan individer balanserer ressurser mellom nåværende reproduksjon og fremtidige overlevelse og reproduksjon. Slike balanseganger er vanskelig å kvantifisere ved hjelp av observasjonelle studier og man har derfor tatt i bruk eksperimentelle tilnærminger selv om dette er mer eller mindre fraværende i studier av store og frittgående pattedyr som f.eks. rein (*Rangifer tarandus*).

Ved å bruke tre eksperimenter (Bårdsen m.fl. 2008, *Ecology*; 2009, *Oikos*), et observasjonsstudium (Bårdsen m.fl. 2010, *Oecologia*) samt et modellarbeid (Bårdsen m.fl. akseptert, *Oikos*) har vi vist at klima og klimaendringer påvirker hvordan reinsimler balanserer allokering av ressurser til reproduksjon versus overlevelse: (1) En forverring av vinterforhold førte til at simlene neste sommer reduserte investeringen i kalv, og isteden satset på oppbygging av kroppsreserver. En tilsvarende forbedring av vinterbetingelsene måtte imidlertid foregå over flere år før simlene var villige til å øke den reproduktive investeringen. (3) Vinterforholdene påvirket ikke bare investeringen i kalv, men også kostnadene knyttet til reproduksjon. Reproduksjonskostnader var særlig tydelig for de minste simlene der det ble dokumentert at vinterklima i kombinasjon med en økning reintallet resulterte i nedsatt reproduksjon og redusert kroppsmasse for simlene. Vi fant imidlertid også en forskjell i kvalitet på tvers av individer siden simler med reproduktiv suksess et år opplevde en større sannsynlighet for å produsere en kalv i det påfølgende året. (4) De asymmetriske konsekvensene av forbedring og forverring koblet til et uforutsigbart vintermiljø viser at reinsdyr har utviklet en risikosensitiv investeringsstrategi der simlene avpasser bygging av kroppsreserver i forhold til hva slags vinter de forventer skal komme. Under vedvarende tøffe og uforutsigbare vinterforhold var den optimalt strategien å allokere færre ressurser til reproduksjon. Dette førte til at simlene økte sin egen kroppsmasse, noe som også gjorde at simlene økte sannsynligheten for å overleve den kommende vinteren. På samme måte var det optimalt for simlene å allokere mer ressurser til reproduksjon når de opplevde vedvarende gode og forutsigbare vinterforhold.

Dette viser at miljømessige forhold påviker reinsimlens livshistorie, og dette kan også ha konsekvenser for populasjonsdynamikken. Denne typen risikosensitiv justering av simlenes reproduktive allokering gjør at simlene står bedre rustet til å klare seg gjennom perioder med redusert mattilgang. Scenarioer for fremtidige klimaendringer i Fennoskandia predikerer i hovedsak et økt skifte mellom varme og kalde perioder gjennom vinteren samt økt nedbørsintensitet gjennom hele året. Under dette scenarioet, vil man kunne forvente at simlene blir mer risikosensitive i fremtiden, men modellstudiet viser at dette bare er mulig opp til et gitt punkt hvor negative klimaeffekter vil føre til utryddelse. Dersom man ønsker å predikere hvordan forventede klimaendinger vil påvirke naturlige populasjoner, er det avgjørende å forstå hvordan klimatiske prosesser påvirker individers evne til å endre sin atferd.

Can female reindeer adapt to climate change?

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In ecology the trade-off between current reproduction and future survival and reproduction, is widely studied. It is difficult, if not impossible, to quantify trade-offs between competing demographic traits using observational study protocols alone. While experimental studies have been widely used to quantify trade-offs in other taxa such as birds, virtually no experimental studies have been carried out on large and free ranging mammals such as reindeer (*Rangifer tarandus*).

By combining three experiments (Bårdsen et al., 2008, *Ecology*; 2009, *Oikos*), one observational study (Bårdsen et al., 2010, *Oecologia*) and one theoretical model (Bårdsen et al., in press, *Oikos*), it has been shown that: (1) Females subject to reduced food availability in one winter promptly reduced their reproductive allocation the following summer to increase their own autumn body mass. In contrast, short-term improved conditions did not result in increased reproductive allocation. (2) Long-term improved winter feeding conditions did, however, result in increased reproductive allocation. (3) Reproduction was costly, especially for smaller females, as occasional harsh winters and high population density resulted in reduced reproduction and lowered female body mass. Moreover, successfully reproducing females produced smaller offspring in the coming year relative to barren ones. Reindeer also differ in quality as successfully reproducing females' showed an increased probability of reproducing in the following year. (4) During harsh and unpredictable winter conditions, the optimal reproductive strategy was a low reproductive allocation. Under such conditions females increased their autumn body mass to enhance their own chances of survival during the coming winter. Conversely, the optimal reproductive strategy in benign and predictable conditions was a higher reproductive allocation.

Effects of environmental conditions on life histories have important consequences for both individual survival and reproduction, and hence also on population dynamics. The main conclusion from the aforementioned studies is that female reindeer adjust their reproductive allocation in order to buffer periods of low food availability in a risk sensitive manner. Scenarios for future climate change in Fennoscandia generally predict shifts between warm and cold periods during winter coupled with a year-round increased intensity of precipitation. Provided that these scenarios are correct it is to be expected that female reindeer will adopt more risk averse life histories in order to buffer negative effects of climate, but simulations show that this kind of buffering will only be possible up to a certain point where extinction is inevitable. Consequently, if we are going to make predictions pertaining to how future climate change will affect biological populations it is paramount to increase our understanding in relation to how climatic processes affect individuals' life histories.

Klimaendring, effektscenarioer og tilpasningsmuligheter for reindrifta i Norge

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Forventede framtidige klimaeffekter er: Kortere og mer snøfattige vintre, økt frekvens av fryse-tine-sykluser samt høyere skoggrense/tregrense og gjengroing av lavalpine områder med reduksjon av lavrike plantesamfunn. Effektene av økte temperaturer sommer, høst og vår for reindrifta forventes å bli a) gjengroing/forbuskning åpne heisamfunn, samt heving av skog- og tregrense vil føre til reduksjon av både sommerbeite- og vinterbeiteområder i subalpine og lavalpine områder, eks. Finnmarksvidda og b) lengre vekstsesong og forskyving i balansen mellom bruk av vinter- og barmarksbeiteområder. Økte vintertemperaturer vil ha 2 hovedeffekter for beitetilgjengelighet som er regionalt forskjellige: c) De kontinentale områdene vil få mer usikre vintre; hyppigere fryse-tine-sykler og påfølgende "låsing" av beiter og d) De oseaniske områder vil bli mindre usikre som vinterbeiteområder da middeltemperaturen det meste av vinteren er over null vil medføre mindre snødekke og økt beitetilgjengelighet. Styrken av endringene vil i stor grad være knyttet til hvor stor temperaturøkningen faktisk blir.

Klimaendringene kan forsterke konflikter mellom reindrifta og andre arealbrukere, så vel som internt i reindrifta. Mulighetene til å tilpasse seg ved endringer i beitebruk kan begrenses av andre arealinteresser, særlig når det er sterk konkurranse. Særlig i Finnmark, vil reintettheten og tettheten mellom reinflokkene begrense mulighetene til å endre beitebruken. Klimaendringene skaper altså behov for økt fleksibilitet til arealbruksendringer i reindrifta, endringer som berører både andre arealbrukere og organiseringen av reindrifta internt. I Troms/Nordland/ Nord-Trøndelag har man ulike typer beiteområder innen eget reinbeitedistrikt og alternative beiteområder ved behov. Det betyr at reindrifta må tilpasse seg andre interessers arealbruk, eksempelvis hyttebygging, og de beste beitetilpasningene vurdert fra et reindriftsfaglig synspunkt vil derfor ikke alltid la seg gjennomføre i praksis.

Climate change, effect scenarios and adaptation processes for reindeer management in Norway

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1. Background

The overall possible climate change effects on reindeer management are complex, and to some extent uncertain and contradictory, and therefore difficult to assess. Expected effects also will vary over climate zones, altitude and latitude. They will be both direct on pasture, animals, and migration possibilities and indirect as e.g. increased land-use conflicts. However, the major determinants will be the changes in temperature and precipitation, as well averages as variability. In sum, possible climate effects on reindeer management may become (Tømmervik et al., 2005, SOU 2007:60, Riseth et al., 2009):

- Increased production on summer pasture (alpine areas) due to increased temperatures and length of growth season
- Elevation of tree and forest line will tend to shrink the area of alpine pasture at the cost of forest and shrub expansion
- Increased summer temperature and precipitation will increase insect harassment with potential serious effects on grazing time and also risk of diseases.
- Shorter winters and thinner snow cover, but increased magnitude of rain on-snow events
- Troubled season migration possibilities due to shorter time of snow and ice coverage
- Increased conflict-level with possibly expanding industries of forestry, agriculture and tourism

Regionally the main difference in climate effects of the reindeer management area in Norway will be between regions with favorable (typically Finnmark and Sør-Trøndelag/Hedmark) and unfavorable winter climate as in Troms, Nordland, and Nord-Trøndelag (Tveraa et al., 2007, Lie et al., 2008). One important probable climate change trend is that the situation in the areas with 'good' winter climate will tend to approach the situation in areas with 'poor' winter climate.

2. Approach, methods and data

Our approach is based on going from registered variations in winter and summer climate and effects via climate scenarios to prospects of future climate effects and to assessments of adaptation possibilities.

2.1 Snow and winter conditions

Available climate scenarios and historical satellite based data sets of snow coverage and snow depth provide a basis for the study of variations in snow amounts. By developing a database of satellite based snow maps from the period 1980 to present, the variability of snow conditions can be used to prospect the local snow conditions 50-100 years ahead using already existing climate scenarios from met.no and temporal/spatial disaggregation with historical representative snow maps. The data sources used are:

-Envisat ASAR wideswath: 2002-2010 (100 m resolution, 3-5 times per week, cloud penetrating, sensitive to wet snow, cannot divide between dry snow and snow-free ground)
-Terra MODIS NDSI product: 2000-2010 (500 m resolution, daily coverage, cloud problems, sensitive to snow fraction)
-Quikscat Ku-band scatterometer data: 1999-Nov 2009 (2.5 km dissolution, daily observation, sjoner, cloud penetrating)
-Local meteorological data (daily observation of snow depth, mean temperature, and precipitation)
-Static maps (vegetation mask, digital altitude model)
-Climate scenarios from met.no (Control 1960-1990, present time, 1980-2008, future, 2070-2100 (different scenarios based on assumptions on climate gas omissions).

2.2 Length of growing season

Future onset of the growing season can be modelled under different climate change scenarios. Changes in the growing season can be studied by examining changes in the remote sensing-based Normalized Difference Vegetation Index (NDVI[1]) value. There are also relationships between climate variability and fluctuation in NDVI and between NDVI and productivity (e.g. Karlsen et al., 2006). Several studies confirm the relationship between variation in NDVI and population dynamic (e.g. Pettorelli et al., 2005, Herfindal et al., 2006). A basis is to map, for all Norway, the present onset and end of the growing season for the 2000 to 2007 period based on MODIS-NDVI satellite data with 250m resolution (Beck et al., 2007, Karlsen et al., 2008, 2009a). Next step is to study the relationship between climatic variables and NDVI in selected regions along the costal-inland gradient. For the development of a climate driven model for the future onset of the growing season satellite data, climate change data and land cover maps will be integrated in ArcGIS. The last step is to derive maps of the future onset of the growing season based on different climatic change scenarios for the next 50 to 100 years, with a special attention to potential future extreme years.

2.3 *Effects on pastures and animals*

The accessibility of reindeer pastures from different years heading back to 1980 will be assessed using existing digital vegetation maps (Tømmervik et al. 2004), using traditional knowledge data and snow map data. Models for quantification of carrying capacity of reindeer pastures (winter and summer) including snow beds will be used in order to quantify and assess the change of vegetation in the pastures due to change in snow cover (e.g. snow beds). The frequency of rain-on-snow (ROS) and icing events that may induce development of mould and micro-fungi detrimental for the reindeer will be analyzed against observations from reindeer herders and data on loss of reindeer from the authorities.

2.4 Pasture adaptation

Exploration of adaptation possibilities is based on qualitative case study research with interviews of key informants and document analysis, including (participant) observation, as far as this is relevant for contemporary cases. Next step will be assessment of production adaptations possibilities based on cultural knowledge as well as production and resource economical analysis. Historical and contemporary experience in how reindeer holders (have) adapt(ed) to climate change and other externally imposed changes can be used to study possible mechanisms of change and re-combination. This knowledge is scattered partly as traditional knowledge, practices and personal memories and partly as literature and archival data. A final step will be to outline and evaluate consequences of different future scenarios for reindeer husbandry adaptation to climate change, given the adaptation possibilities available. The most important matter when looking into the future this way is to make several different scenarios showing different paths of development, and to make each of the scenarios logically consistent (Arbo et al., 2007).

3. Prelimary findings

3.1 Physical snow conditions

Regional dynamically downscaled climate scenarios like e.g. HIRHAM (Hanssen-Bauer et al., 2005) indicates that the amount of snow will decrease dramatically in a 50-100 year perspective. Further downscaling using hydrological models (Vikhamar-Schuler et al., 2006, 2010) indicates that decreases in Troms and Finnmark from present to 2100 is 60-80% less snow along the coast and 20-40% less in continental area but the uncertainties are high. The length of the snow season will also be shorter by 2-8 weeks depending on location. A first version snow time-series 2005-2010 for Kautokeino is produced. From this can be derived:

-First/last date for snow/not-snow,
-Snow season-length (geographical),
-Document (Rain-on–snow) ROS-events (geographical extension)
-Detect areas with high probability of ice-blockage

[1] The NDVI is defined as: NDVI = (Ch2-Ch1)/(Ch2+Ch1), where Ch1 and Ch2 represent reflectance measured in near infrared and red channels, respectively.

Based on downscaled climate scenarios our preliminary findings for Kautokeino are: -
maximum snow depth will be reduced from 60 cm to 40 cm and
the length of the snow season will be shortened in both ends, from 230 to 200 days.
i.e. 1 month shorter winter.

3.2 Length of the growing season and start of spring

Earlier onset of the growing season means increased vegetation biomass and also reindeer body mass (Petorelli et al., 2005). Our group has though performed preliminary analyses indicating that how fast the greening is coming, influences autumn calf weights. The results will be prepared further before publication.

Based on GIMMS-NDVI data for the period 1982-86 Karlsen et al. (2009b) found that for most of the mountain ridge of middle and northern Scandinavia that the total length of the growth season had been relative stable. Climate change will though have different responses on the onset of the growing season due to the degree of continentally (Karlsen et al., 2007) as 1°C increase of spring temperature corresponds roughly to 7-9 days earlier onset of the growing season in oceanic regions, compared to less than 5 days earlier in continental regions as Finnmarksvidda .

Future regionalized climate scenarios provide somewhat varying predictions, but for Finnmark the start of spring (greening) will, at the end of the present century, come 2-4 weeks earlier than now, and up to one week earlier at the coast than in the inland (Karlsen et al., 2007). We have performed some first version modelling to predict the spring situation at calving areas both on the coast and in the inland, but this work will be redone using newer more finetuned climate scenarios. However, our preliminary findings are that the coastal calving areas are more sensible for increase in spring temperatures compared with the continental ones. This mean that at even spring temperature increases across the study area coastal areas can expect earlier onset of the growing season compared with continental ones. Accordingly, though the temperature scenarios indicate higher spring temperature increase in the continental parts this difference compensates for the oceanic-continental effect and leads to about equal changes for all calving areas.

3.3 Ecological effects

It is established knowledge (Kullman, 2006) that temperature increase means tree-line and forest-line elevation and expansion of forest species and shrubs into alpine areas and accordingly a threat to summer pasture areas of reindeer. Climate-induced changes of the start and the progress of the growing season (Karlsen et al., 2007a) may result in significant consequences to the development of calves and subsequently to the population demography of reindeer, mediated through spatial and temporal changes in the distribution of high quality food.

As for winter climate Tveraa et al. (2007) concluded that lack of direct regulation in reindeer populations subjected to low harvesting in Norway resulted in high vulnerability to harsh winter weather (e.g. snow conditions). Rain falling on snow is the principal factor causing ice encasement of vegetation (Putkonen & Roe, 2003). Bartsch et al. (2010) detected a pattern in Siberia where the number of ROS-refreezing events per winter is lowest in the eastern, most continental parts and increasing towards the west, and as it is predicted an increasing number of ROS by increasing air temperature (Rennert et al., 2009), most pronounced where temperatures are low currently (Ye et al. 2008). Accordingly, we can expect increased problems associated with thaw-freeze in continental areas.

When the sub-snowpack rain water pool at the soil surface freezes, it gives up latent heat and warms the soil beneath and the snow above, resulting in near-surface temperature at 0° C (Putkonen & Roe, 2003). This increase of temperature promotes growth of mould and other types of micro-fungi, which ungulates tend to avoid (Kumpula et al., 2000). However, these fungi can be pathogenic and thus detrimental to vegetation types and species important as forage for reindeer (Gaare & Willmann, 1997, Kumpula et al., 2000). During fieldwork in Saarivuoma our group learnt that mould seems to be a problem associated with heavy snow on not-frozen ground in autumn and suggest that this problem should be explored further in cooperation between reindeer herders and veterinary science (Riseth et al., 2011).

3.4 Pasture use adaptations

Overall, it will be relevant to explore whether some areas will develop pasture balance situation giving reason to reconsider current seasonal patterns. Given the changes we expect in climate and weather conditions, and the adaptation possibilities available, possible future consequences can be outlined within Norway:

- For Troms, Nordland and Nord-Trøndelag coastal areas can achieve more stable winter conditions than present and the alternative of moving to continental areas in winter can accordingly become less relevant.
- Parts of the areas with currently stable winter conditions (Finnmark and Sør-Trøndelag/Hedmark) areas can become less stable and become dependent on use of supplementary feeding, with high extra cost or they will need reorganization of the seasonal pattern, or in worst case a reduction of the sustainable number of animals.
- The combination of increased growing season and shorter winter make the scenario of combining a longer stay in the summer pasture areas and shorter stay in the winter pasture areas highly relevant. Combined with a possible reduction of summer pasture capacities, this can make summer pasture the minimum factor where it now is the opposite.

Our research group is exploring to which extent herder knowledge of adaptation possibilities can confirm or reject the practical relevance of different adaptation. In winter flexibility of moving other areas seems to be a core issue (Päiviö, 2006, Riseth et al., 2011). We will come back to further analyses.

Changes in pasture use pattern will also affect the relations between reindeer husbandry and other land use interests. Further, increased pressure of encroachments at the coast of Finnmark, can e.g. limited the possibilities for changes in seasonal pasture use pattern. External impacts also strikes randomly within herding areas, giving an other reason for increasing the flexibility of land use within reindeer management.

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Vekt og produksjon hos rein

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Bestanden av tamrein i Norge har vokst fra 172 000 til 243 000 i perioden 1999-2009. Denne økningen har i hovedsak vært konsentrert til Finnmark fylke, som har ca 73% av totalbestanden av tamrein i Norge, og der enkelte reinbeitedistrikter har doblet reintallet i perioden. Høye reintall er regnet som en hovedårsak til en synkende trend i slaktevekter. I tillegg har reineierne de siste årene rapportert en synkende andel simler som føder kalv, og økte tap av kalver til rovdyr. Totalt sett har det vært en betydelig reduksjon i produksjonen av kalv i de siste 5 år. Utviklingen i mange reinbeite-distrikter har vært bekymringsverdig og medført ett behov for økt kunnskap om hva som bestemmer kalveproduksjonen i tamreinflokkene, og hvor store tapene er på forskjellig stadier av kalvens ut-vikling. Det er velkjent at en simles reproduksjonspotensial er avhengig av simlas kondisjon, og kroppsmasse har vært foreslått som ett enkelt og godt mål på kondisjon. Jeg vil rapportere fra studier gjort på kalveproduksjon i norsk tamreindrift med særlig fokus på variasjon i tid og mellom områder med hensyn på sammenhengen mellom simlas alder og vekt, og sannsynlighet for drektighet og tidlig tap av kalv.

Body mass and calf production in semidomesticated reindeer in Norway

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The population of semi-domesticated reindeer in Norway has grown from 172000 to 243000 in the period from 1999 to 2009. This increase has mainly been due to population increases in the northern-most county in Norway, Finnmark, which hold 73% of the total population of semi-domesticated rein-deer in Norway, and where some management districts have experienced a 100% increase in the population over the period. High population size is regarded as a main course for a decreasing trend in slaughter weights. In addition, the reindeer herders have reported that the proportion of female rein-deer that give birth is decreasing, and there are increasing losses of calves to predation. In total there has been a substantial decrease in calf production over the last 5 years. This trend has given cause for concern, and a need for better understanding of the processes that determine the calf production in the herds, and the losses at the different stages in the calves' development. It is well known that the reproductive success of female reindeer depend on her body condition, and body mass has been suggested as a simple and valid measure of condition. I will report the results from studies on calf production and losses in Norwegian semi-domesticated reindeer. I will focus on variation in time and between reindeer management districts in the relationship between female age and weight, and the probability for pregnancy and early calf losses.

Beitebruk hos rein

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Klimaet i Arktis har blitt varmere og satellittbilder viser at det er blitt en økning i plantebiomassen i arktiske strøk. Flyfoto viser at denne økningen er relatert til økt vekst og utbredelse av kratt, og da spesielt vierkratt (*Salix* spp.). Dette har skapt mye oppmerksomhet fordi endringer i vegetasjonsdekket påvirker varmemagasineringen og gir positiv tilbakekobling til klimasystemet. I den forbindelse er det blitt påpekt at økologisk ingeniørskap mellom herbivorer og planter kan være med på å hemme den klimadrevne grønningen som skjer i Arktis. I Finnmark, Norge, er tettheten av rein (*Rangifer tarandus*) høy og vi har vært interessert i å undersøke næringsvalg og habitatbruk hos rein under disse forholdene med tanke på å forstå mulige effekter av reinbeiting på vegetasjonen i sub-arktisk område.
39 rein ble utstyrt med Televilt gps-klave i juni 2006 og juli 2007 til september i begge årene. Funksjonssvikt i klavene gjorde at vi fikk brukbare data fra 19 dyr. Et IRS liss 3 satelittbilde, tatt 30. juli 2006, ble klassifisert i 12 ulike vegetasjonstyper ved hjelp av vegetasjonsdata fra 2005 og 2006. Vi regnet ut reinens seleksjon av ulike vegetasjonstyper i tre tidsperioder i løpet av sesongen. Vi undersøkte også hvordan dyra bruker høydegradienter i terrenget, hvor stort areal de benytter seg av og hvordan de fordeler seg utover beiteområdet fra dag til dag.
I dette distriktet selekterer reinsdyrene vierkratt, som kun dekker 1,1% av totalarealet, snøleier (6,5% av arealet) og dvergbjørk (*Betula nana*) dominert hei (8,1% av arealet). Det ser ut som at de velger bort bjørkeskog (*Betula pubescens)* skadet av bjørkemålere (*Epirrita autumnata* og *Operophtera brumata)* (3,1% av arealet). For resten av de 12 vegetasjonstypene viser de liten eller ingen seleksjon. Det er heller ingen tydelige trender i seleksjon utover i sesongen, verken innad i eller mellom typene.
I løpet av sesongen skjer det et skifte i dyrenes bevegelsesmønster. Fra å gå i flokk over store arealer midt i høydegradienten tidlig, trolig på leting etter flekker av vegetasjon med høy beitekvalitet, til å spre seg ut og bruke mindre arealer noe lavere i terrenget seinere. Det kan tyde på at dyrene har homogenisert produktiviteten over beitearealet slik at kvaliteten blir relativt lik over hele arealet utover i beitesesongen.
Andre studier fra Finnmark finner reduksjon av vierkratt og høyproduktiv vegetasjon i høytetthetsdistrikter. Både seleksjons og bevegelsesmønsteret vi finner er i samsvar med disse funnene. Sett under ett kan resultatene tyde på at reinsdyr ved høye tettheter er effektive økologiske ”ingeniører” som kan hemme noen av effektene av den klimadrevne grønningen i sub-arktiske områder.

Reindeer' use of summer pastures

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The arctic climate has become warmer and satellite images show an increase in plant biomass in arctic ecosystems. Aerial images show that the increase is related to increased growth and dispersal of shrubs, in particular Willows (*Salix* spp.). These findings have been widely discussed because an increase in the vegetation cover in the Arctic affect earth's heat-reservoirs and pay a positive feedback to the climate system. In connection with this debate it has been indicated that ecologic engineering between herbivores and plants can moderate the climate driven greening of the Arctic. In Finnmark, Norway, the density of reindeer (*Rangifer tarandus*) is high and we wanted to investigate their habitat use and forage selection under these conditions in order to understand possible effects of reindeer-grazing on sub-arctic vegetation.
A total of 39 reindeer were equipped with Televilt gps-collars in June 2006 and July 2007. They were collected in September in both years. Because of technical problems we got usable data from a total of 19 animals. A IRS liss 3 satellite image from July 30 2006 was classified into 12 vegetation types using ground truth data from 2005 and 2006. We calculated habitat selection coefficients for three periods through the investigated period. We also investigated how the animals use the elevation gradient, the size of their utilized area and how they disperse over the pasture on a daily basis through the study period.
In the investigated area the animals select willows, which cover 1,1% of the available pasture area, snow fields (6,5% of the area) and dwarf birch (*Betula nana*) dominated heath (8,1% of the area). They also seem to negatively select birch (*Betula pubescens)* forest damaged by geometrid moths (*Epirrita autumnata* and *Operophtera brumata)* (3,1% of the area). The rest of the 12 vegetation types detected were little or not selected. We find no obvious trends in selection patterns over time, neither in nor between vegetation types.
There is a shift in the animals' movement pattern during the investigated period. They show higher aggregation and utilize large areas in the middle of the elevation gradient early, and then they disperse and utilize smaller areas lower in the terrain late in the season. This probably reflect search for high quality patches of forage early in the period, and that the productivity in the area is homogenized such that the forage quality is equalized later in the season.
Other studies in Finnmark have shown a reduction of willows and productive vegetation in high density reindeer herding districts. Both the selection and movement pattern we detect here is in accordance with the findings in these studies. Collectively, these results indicate that reindeer at high densities are effective ecological "engineers" that can moderate some of the effects of the climate driven greening in an sub-arctic area.

Upptäckt och förvaltning av förändringar i betesförhållanden

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I renskötseln används huvudsakligen naturligt bete och eftersom betet är en avgörande begränsande faktor för renhjordens produktivitet, betyder det att man ständigt måste anpassa sig till förändringar i betesresurserna. Långsamma klimatcykler kombinerat med oförutsägbara variationer i väder och olika externa störningar, förändrar betets kvalité och tillgänglighet och komplicerar förvaltningen av betesresurserna. Upptäckt av förändringar på ett tidigt stadium och solid kunskap om resurssystemet är avgörande för att kunna anpassa nyttjande av betet till skiftande förhållanden.

Adaptiv förvaltning ger stöd för beslut om förvaltningsåtgärder i dynamiska resurssystem, där man på flera plan måste ta hänsyn till osäkerheter. Grundläggande informationskällor i adaptiv förvaltning är kontinuerliga mätningar av indikatorer på förändringar i systemet, frekvent utvärderade och förbättrade teoretiska modeller av systemet, och iakttagelser från resursanvändarna. Informationen från dessa källor kombineras för att förutsäga sannolika långtidsscenarier och hur förvaltningsåtgärder kan påverka dessa.

Vi har undersökt två möjliga indikatorer av förändringar, en för vintersäsongen och en för den snöfria perioden, samt konstruerat en dynamisk modell av ren-bete systemet med syfte att kunna förutsäga hur dessa indikatorer kan reagera under olika förhållanden. Utifrån våra resultat, presenteras här några saker som man bör tänka på när man implementerar adaptiv förvaltning i renskötseln.

De indikatorer vi studerat valdes för att vara okomplicerade och tidseffektiva nog att enkelt kunna införlivas i betesförvaltningen i en sameby. Som indikator för förändringar i vinterbetesresursen har vi med lovande resultat undersökt användning av lavhöjdsmätningar. Som indikator för förändringar i betesresurserna under den snöfria perioden har vi undersökt slaktkroppsdata från den kommersiella slakten på hösten.

Den dynamiska modellen består av tre integrerade moduler, en för lavbetesdynamiken, en för renens energimetabolism och tillväxt samt en för hjordstrukturdynamik. Lavresursen modelleras som lavhöjd och antas ha logistisk tillväxt. Renens tillväxt och kroppsreserver modelleras som strukturell vikt, som tillväxer enligt en von Bertalanffy kurva, samt vikten av kroppsreserver. Energiintaget under sommar perioden antas följa en sinuskurva med Holling typ II täthetsberoende. Energiintaget under vintern modelleras som medelvärdet av tillgänglig energi från lav per ren och dag samt med minst 10% från andra växter. Denna andel ökas om lavresursens storlek begränsar intaget. Renens överlevnad och fekunditet är beroende av kroppskonditionen. Stokastiska element i modellen är lavens tillväxthastighet, lavens tillgänglighet under vintern (p.g.a. snöförhållanden), och sommarbetets kvalitet. Med denna modell har vi undersökt hur responsen på olika populationstätheter uttrycks i indikatorerna (slaktvikt och lavhöjd).

Changes in grazing conditions – detection and management

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In reindeer herding constant adaption to changes in the resources are required. Long-term climatic cycles, combined with unpredictable variations in weather and various external disturbances, change the quality and availability of the pasture and thus complicate the management of the grazing resources. Detection of ongoing changes at an early stage and thorough knowledge about the resource system are crucial in order to adapt the use of resources to the changing conditions.

Adaptive management provides a supporting framework for management decisions in dynamic resource systems, where uncertainties have to be taken into account. Fundamental information sources in adaptive management are i) continuous measurements of indicators of change in the system, ii) constantly evaluated and improved theoretical models of the system and iii) observations done by resource users. Information from these sources is then combined to predict likely long-term scenarios, and effects of management actions in response to these scenarios.

We investigated two possible indicators of changes in the resource bases for the winter and snow-free seasons, respectively, and constructed a dynamic model of the reindeer-pasture system, that can be used to predict responses in indicators to different conditions and under various assumptions. Based on our result we give some suggestions of what to consider when implementing adaptive management in reindeer husbandry.

The investigated indicators were chosen to be simple and time-effective and easy to incorporate in the practical management of grazing resources within a herding district. As indicator of changes in lichen resources we have, with promising results, evaluated lichen height measurements. For the grazing resources during the snow-free period, we examined carcass measures from the commercial autumn slaughter, as indicator.

The dynamic model is constructed from three integrated modules, one for lichen dynamics, one for energy and metabolism of the individual reindeer, and one for the herd structure dynamics. The lichen resource is modelled as lichen height, and assumes logistic growth. Individual growth and body resources of reindeer are modelled with two variables, structural mass and mass of body reserves. The structural growth is assumed to follow the von Bertalanffy's growth curve. Energy intake during summer is assumed to follow a sinus curve, with a Holling type II density dependence. Winter energy intake per day is set to the mean value of energy in available lichen per reindeer and day and at least 10% energy from other sources. This percentage is increased if the lichen resource limits the energy intake. Reindeer survival and fecundity are assumed to depend on body condition. Stochastic elements in the model are lichen growth rate, lichen availability due to snow conditions during winter and summer pasture quality. Using this model we investigated how the response to population density is expressed in the indicators (carcass weight and lichen height).

Fotråte (klauvråte, smittsom klauvsukdom, slubbo) hos rein med fokus på et utbrudd hos villrein

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Fotråte (klauvråte, smittsom klauvsjukdom, slubbo) forårsakes av bakterien *Fusobacterium necrophorum*. Sjukdommen ble betraktet som det største helseproblemet som fantes i nordnorsk reindrift på 1800-tallet og begynnelsen av 1900-tallet. Den var knyttet til den intensive driftsformen, med små flokker og hyppige samlinger på små arealer i forbindelse med melking, som ble praktisert på den tiden. Denne regelmessige samlingen på små opptråkka områder forurenset med avføring fungerte åpenbart som et godt miljø for bakterien, og som et sted for smitteoverføring mellom dyr. Etter overgang til mer ekstensive driftsformer i siste halvdel av 1900-tallet, synes denne sjukdommen mer eller mindre å ha forsvunnet fra reindriften. *F. necrophorum* er vanskelig å isolere (dyrke frem) i laboratoriet og bakterien ble ikke tilfredsstillende identifisert under de tidligere sjukdomsutbruddene hos tamrein. Fotråte har ikke blitt rapportert som et helseproblem i viltlevende populasjoner av rein før et nylig utbrudd i en norsk villreinpopulasjon som vil bli presentert i dette foredraget. I dette utbruddet ble bakterien identifisert og karakterisert ved hjelp av moderne bakteriologiske teknikker.

Norge forvalter de siste restene av den opprinnelige ville tundrareinen (*Rangifer tarandus tarandus*) i Europa. Dyrene lever i fjellområdene i Sør-Norge, og fordeler seg på 23 atskilte populasjoner. Utbruddet av fotråte opptrådte i populasjonen i Rondane på seinsommeren og høsten 2007 og 2008. Denne populasjonen består av ca. 4000 vinterdyr, som, på grunn av riksvei 27, er delt i en nordre og en søndre sub-populasjon. I 2007 var sjukdomsutbruddet avgrenset til populasjonen i sør hvor ca. 2% av dyrene ble rapportert sjuke (det reelle tallet var sannsynligvis høgere). I 2008 var situasjonen motsatt, med mange sjuke dyr i nord og et fåtall tilfeller i sør. I de to etterfølgende årene, 2009 og 2010, er det bare oppdaget enkelttilfelle. Majoriteten av angrepne dyr har vært kalver. Dyrene har vist sterk halthet og normalt har bare en fot vært rammet. Utbruddene i 2007 og 2008 opptrådte etter to somrer med uvanlig mange dager med nedbør og høg lufttemperatur. Det er rimelig å anta at disse værforholdene har begunstiget bakterien sin overlevelse på bakken, og overføringen av smitte fra sjuke til friske dyr.

Materiale fra i alt 26 dyr ble undersøkt i laboratoriet. De angrepne beina var svulne på grunn av omfattende betennelse i bløtvevet i tå-området. Ofte var også sener, seneskjeder, ledd og knoklene i foten medinndratt. Ved konvensjonell bakteriologisk undersøkelse lyktes vi å isolere den sjukdomsfremkallende bakterien (*F. necrophorum*) fra seks av de 26 undersøkte dyrene. Ved anvendelse av moderne teknikker (fluoriserende in-situ hybridisering) for direkte påvisning av bakterien i sjukt vev ble *F. necrophorum* påvist i store mengder hos samtlige dyr.

Litteratur / Literature

Handeland K., Boye M, Bergsjø B., Bondal H, Isaksen K., & Agerholm J.S. 2010. Digital necrobacillosis in Norwegian wild tundra reindeer (*Rangifer tarandus tarandus*). *Journal of Comparative Pathology* 29-38.

Digital necrobacillosis (slubbo) in reindeer with focus on an outbreak in a wild population

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Digital necrobacillosis (Sami: slubbo), caused by the bacterium *Fusobacterium necrophorum*, was regarded the most serious health problem seen in North Norwegian reindeer herding in the 1800s and early 1900s. The disease was linked to the intensive reindeer herding practised at that time, with small flocks that were frequently gathered in small areas for milking purposes. This regular crowding in small muddy and faeces-contaminated areas apparently functioned as a good environment for the bacterium and site of transmission between animals. Since changing to more extensive reindeer herding in the second half of the 1900s, this disease has more or less disappeared. *F. necrophorum* is difficult to isolate in the laboratory and there is a lack of satisfactory identification of the bacterium in the reported disease outbreaks in semi-domesticated reindeer. Necrobacillosis in wild reindeer populations was not reported until the recent outbreak reported in this lecture. In this outbreak the causative bacterium could be satisfactory identified and characterized by modern bacteriological methods.

Norway harbours the last remnants of the original wild tundra reindeer (*Rangifer tarandus tarandus*) in Europe. The animals live in the mountain areas of southern Norway, and are dispersed between 23 populations. The outbreaks of digital necrobacillosis occurred in the population located in the Rondane area, in late summer and autumn 2007 and 2008. This population consists of some 4000 winter animals separated into northern and southern subpopulations due to a trunk road, which bisects the region. In 2007, the outbreak was confined to the southern population where approximately 2% of the animals were reported to be affected (the real number was probably higher). In 2008, the situation was in the opposite, with many affected animals in the northern population and only a few cases in the southern. In the two subsequent years, 2009 and 2010, only one single case per year was detected. The majority of affected animals were calves. Sick animals were severely lame and normally only one foot was affected. The outbreaks in 2007 and 2008 appeared after two summers with an unusual high number of days with precipitation and high air temperature. It is reasonable to assume that these weather conditions favoured bacterial survival on the ground, and transmission of the bacterium from sick to healthy animals.

Materials from 26 animals were examined in the laboratory. Affected feet were swollen due to severe inflammation in the soft tissue of the toe. Frequently, tendons, tendon sheaths, joints and bones of the foot were also affected. By conventional bacteriological examination, the causative bacterium *F. necrophorum* could be isolated only from six of the 26 animals examined. However, when using modern technics (fluorescence in-situ hybridization) for direct detection of this bacterium in tissues lesions, *F. necrophorum* was found in large amounts in all animals.

Literature in previous page.

Fysiologiske tilpasninger til giftige lavsyrer hos rein

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Reinen er kjent for sin evne til å spise og utnytte lav som næringsemne til tross for lavens høye innhold av antimikrobielle og potensielt giftige antibeitestoffer som usninsyre. Vi søker å forstå mekanismene bak denne tilpasningen. Tanniner er velkjente eksempler på slike antibeitestoffer som kan være giftig både for mikroorganismene i fordøyelsessystemet og for dyret selv. Vi studerer en annen men lignende modell: tilpasning til og håndteringen av fenoliske forbindelser i lav hos reinen og dens vommikroflora [Barboza et al., 2010, Physiological and Biochemical Zoology 83: 764-774]. Økt UV-B stråling forventes å gi økt konsentrasjon av fenoliske forbindelser i en rekke lav- og plante-arter som rein beiter på. Lav syntetiserer og akkumulerer slike sekundære forbindelser kalt lavsyrer (et kjent eksempel er usninsyre), som en beskyttelse mot de skadelige UV-B strålene fra sola, men også som et forsvar mot plantespisere og mikroorganismer.

Som en del av IPY-prosjektet no. 399 EALAT: ”*Climate change and reindeer husbandry*”, har vi studert samspillet mellom usninsyre i lav og reinens vommikroflora med en bestemt målsetning: å bedre vår forståelse av hvilke mekanismer reinsdyret og dets symbiotiske vommikroorganismer har tilpasset for å takle de potensielt giftige og antibiotiske lavsyrene. Vi har isolert og beskrevet en ny bakteriestamme (*Eubacterium rangiferina*) fra reinvomma som er i stand til å vokse i nærvær av opptil 40 mg usninsyre per milliliter [Sundset et al., 2008, Naturwissenschaften 95: 741-749]. Dette er den første kjente beskrivelsen av en vombakterie som er i stand til å tolerere lavsyrer, noe som indikerer at mikroorganismene i vomma til disse dyrene har utviklet mekanismer for å håndtere de antimikrobielle lavsyrene. Vi har også nylig bekreftet at usninsyre faktisk brytes ned av mikrobene i reinvomma, og følgelig ikke absorberes av dyret selv [Sundset et al., 2010 Naturwissenschaften 97: 273-278].

Hovedmålet med dette prosjektet er å identifisere og studere mekanismene som gjør reinen i stand til å spise og å utnytte lav som en viktig kilde til energi og næringsstoffer om vinteren, til tross av det høye innholdet av antimikrobielle og potensielt giftige lavsyrer. Vi er i ferd med å beskrive effekten av usninsyre på vomfloraen til rein, og vårt mål er å identifisere og karakterisere de viktigste nøkkel-artene når det gjelder nedbrytning / avgiftning av usninsyre i reinvomma. Reinsdyrene og deres beiter er av stor betydning for menneskers liv og økonomi i nordlige Eurasia, og kunnskap om mikrobiell avgiftning av usninsyre i reinvomma vil bli enda viktigere med en økt konsentrasjon av fenoliske forbindelser i planter og lav som følge av klimaendringer og økt UV-B stråling i fremtiden.

Physiological adaptations in reindeer to cope with toxic lichen acids

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Reindeer are well known for their ability to eat and utilize lichens as a substrate despite their high contents of antibiotic and potentially toxic antinutrients. We seek to understand the mechanisms behind this adaptation. Tannins are well known examples of antinutritional factors that may be toxic to both ruminal microbes and the tissues of the animal. We address a different yet comparative model: the adaptation and the coping of the reindeer and its rumen microflora with secondary phenolic compounds in lichens [Barboza et al., 2010, Physiological and Biochemical Zoology 83: 764-774]. Enhanced UV-B radiation is expected to increase the concentration of phenolic secondary compounds in a range of lichens and plants eaten by reindeer. Lichens synthesize and accumulate a wide variety of these secondary compounds, such as usnic acid, as a protection against harmful UV-B radiation from the sun but also as a defence against herbivores and microorganisms.

As part of IPY project no. 399 EALAT: *Climate change and reindeer husbandry*, we have studied the interactions between the usnic acid in lichens and the reindeer rumen microflora with a particular goal: to better understand how reindeer and their symbiotic rumen microorganisms have adapted to cope with the toxic and antibiotic lichen acids. We have revealed a novel usnic acid-resistant bacterial strain (*Eubacterium rangiferina*) from the reindeer rumen able to grow in the presence of up to 40 mg usnic acid per millilitre [Sundset et al., 2008, Naturwissenschaften 95: 741-749]. This is the first record of rumen bacteria able to tolerate usnic acid, indicating that rumen microorganisms in these animals have adapted mechanisms to deal with the antibiotic usnic acid. We also recently verified that usnic acid is indeed degraded by microbes in the reindeer rumen, and consequently not absorbed by the animal itself [Sundset et al., 2010 Naturwissenschaften 97: 273-278].

The ultimate goal of this project is to identify and study the mechanisms allowing reindeer to eat and utilize lichens as an important source of energy and nutrients, despite their high concentrations of antibiotic and potentially toxic secondary compounds such as usnic acid. We are currently characterising the effect of usnic acid on the rumen microbiome and its detoxification activity, searching to identify and characterise the key usnic acid detoxifying microorganisms in the reindeer rumen. Reindeer and their pastures are of great significance to human life and economy in the Arctic and knowledge on rumen microbial detoxification of usnic acid in reindeer will become even more important as the concentration of phenolic compounds in plants and lichens increase due to climate change and enhanced UV-B radiation.

Renhälsa – ökad kunskap genom utbildning och information på nätet

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Renhälsa är ett pågående projekt som syftar till att öka kunskap och kompetens när det gäller hälsa, sjukdomar och parasiter hos renar. Projektet finansieras med bidrag från Sametinget och Jordbruksverket. Det startade 2009 med en serie seminarier dit renägare och lokala veterinärer bjöds in. I projektet ingick även att titta på olika myndigheters och organisationers roll när det gäller renars hälsa. Den viktigaste slutsatsen från detta arbete blev att det är mycket angeläget att bygga upp ett förbättrat system för information, service och kompetensuppbyggnad på området. Det finns stort engagemang för frågan, såväl inom rennäringen som inom berörda myndigheter och organisationer.

Under 2010 har vi skapat en hemsida, som ligger på www.svdhv.se (”Andra djurslag” > ”Ren”), där viktiga sjukdomar och parasiter hos ren beskrivs och där det också finns allmän information om renar och rennäring (med länkar till bland annat Sametinget, SSR, SVA och SLU). Hemsidan öppnades i oktober 2010 och är under utveckling. Fokus är att visa rensjukdomar i bildgallerier, vilka utökas efterhand och kommenteras av patologer och andra experter. Avsikten är att hemsidan ska vara forum för informationsutbyte när det gäller hälsa och sjukdomar hos ren och att den kontinuerlig ska uppdateras med ny kunskap, observationer och bildmaterial.

Inom ramen för projektet har vi arrangerat en vidareutbildning för veterinärer om renens biologi, skötsel och sjukdomar (i oktober 2010). Deltagarna var framför allt yrkesverksamma veterinärer från norra Sverige, men också studenter som läste sitt sista år på veterinärutbildningen. Planen är att upprepa kursen om ett par år och att även genomföra kurser för renägare på samma tema. Inom ramen för projektet arbetar vi också med att finna ett system för redovisning av den slaktskadestatistik som registreras vid renslakten. Medverkande i projektet är, förutom SLU, SVA och SvDHV, Livsmedelsverket, Distriktsveterinärerna/Jordbruksverket samt Sametinget. Projektet har koppling till pågående nordiska projekt som handlar om renens hälsa och sjukdomar (”Rangifer Health Network” och forskningsprojekt om smittsam ögoninfektion hos ren).

Reindeer health – increasing knowledge through education and web-based information

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Reindeer health is an ongoing project aiming at improving knowledge and competence regarding health, diseases and parasites in semi-domesticated reindeer in Sweden. The project is funded from the Swedish Sami Parliament and the National Board of Agriculture. It started in 2009 with a series of seminars for reindeer herders and local veterinarians. We also looked at the role of various authorities and organisations, with relevance for reindeer health issues. The main conclusion from this work was the urgent need to create a better system for information, service and competence within the area of reindeer health. There is a large interest for this issue among reindeer herders and within authorities and organisations of concern.

During 2010, we have produced a website, located at www.svdhv.se (”Andra djurslag” > ”Ren”). On this site there is information about important reindeer diseases and parasites, as well as general information about reindeer and reindeer husbandry (with contact information and links to relevant institutions and authorities). The site was opened in October 2010, and is under development. The main focus is to show reindeer diseases in growing image galleries, commented on by pathologists and professionals. The aim is that the website will serve as a centre for reindeer health and disease information exchange, and that it will be continuously updated with new knowledge, observations and images.

As part of the project we have arranged a course for veterinarians about reindeer biology, husbandry and diseases (in October 2010). Participants were mostly veterinary practitioners from Northern Sweden, but also students doing their last year of veterinary training. Our intention is to repeat this course after some years, and also give courses for reindeer herders on the same topic. In addition, the project is developing a digitized documentation system for the observed pathology and disease findings at reindeer abattoir meat inspection. Partners in the project, besides the National Veterinary Institute, the Swedish University of Agricultural Sciences and the Swedish Animal Health Service, are the National Food Administration, the District Veterinarians/National Board of Agriculture and the Sami Parliament. The project has links to ongoing Nordic projects on reindeer health (“Rangifer Health Network" and research on eye infections in reindeer).

Vil vi få nye sjukdommer og helseproblemer hos reinsdyr i årene som kommer?

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Den samiske reindrifta er bygget på kunnskap om reinen som beitedyr og hvordan en kan utnytte utmarksressurser til produksjon av kjøtt og andre reinprodukter. Reindrifta er på denne måten avhengig av biologi i vid forstand, herunder økosystemers bærekraft og klima. Reindrifta har gjennomgått store endringer, fra en nomadisk/semi-nomadisk struktur med stor grad av selvforsyning, til fast bosetting, fastere arbeidstid og pengeøkonomi, ledsaget av effektivisering og motorisering av drifta. Slike endringer kan også påvirke helse og forekomst av sjukdommer hos rein. I tillegg til avmagring og feilernæring, inkludert problemer som kan oppstå ved fôring av rein, er det infeksjonssjukdommene som er av størst betydning i reindriftsnæringa, og også disse er i endring. Infeksjonen nekrobacillose, som tidligere forårsaket klauvlidelser og store tap ses ikke lenger i denne formen, mens infeksjoner som smittsom munnskurv, forårsaket av et parapoxvirus, må kunne betegnes som en relativt ny sjukdom hos rein.

En kan tenke seg at helsetilstanden hos rein og forekomsten av infeksjonssjukdommer kan endre seg på tre hovedmåter i tida som kommer. For det første kan nye sjukdommer introduseres i reinpopulasjonen. Dette kan skje ved kontaktsmitte fra husdyr eller ville dyr til rein, ved vandring av dyr over landegrenser eller ved import av livdyr fra områder der sjukdommer som for eksempel brucellose kan forekomme. En annen måte sjukdommer kan oppstå på eller opptre annerledes enn tidligere er som en respons på endrede driftsforhold. Dette kan for eksempel forårsakes av økt fôring av rein for å unngå sult og avmagring som følge av et misforhold mellom antall dyr og tilgjengelige beiteressurser. Ved å holde dyr i innhegning og ved bruk av fôrtroer og annet utstyr, øker kontakten mellom dyra, noe som letter overføring av smittsomme sjukdommer. Andre forhold som kan ha samme effekt, kan være lange transporter mellom sommer- og vinterbeiter og til slakteri, eller økt grad av motorisert driving over lange avstander. Disse forholdene fører ofte til økt stress for dyra, noe som igjen virker dempende på immunforsvaret og kan gi økt mottagelighet for sjukdommer. Et tredje forhold som kan spille inn på forekomst av sjukdommer i framtida er klimaendringer. Det forventes økt nedbør, større grad av temperatursvingninger og endrede middeltemperaturer, som kan føre til økt vekst og utbredelse for enkelte beiteplanter, men som også kan medføre hyppigere forekomst av låste vinterbeiter. Endret klima vil også gi endrede levekår for parasitter, og for insekter som fungerer som vektorer for parasitter, bakterier og virus. Ett eksempel er parasitten *Setaria tundra*, som har hatt en økt forekomst og en mer nordlig utbredelse i Finland de siste årene, og som har forårsaket store tap i form av kassasjon av kjøtt. Sjukdommen blåtunge hos storfe, sau og geit, som forårsakes av et virus som har sviknott (*Culicoides* spp.) som vektor, er et annet eksempel på en infeksjon som kan være aktuell hos rein i et langsiktig klimaperspektiv. Også flått (*Ixodes ricinus*) har hatt en nordlig ekspansjon, og kan ha med seg infeksiøse agens som kan infisere rein.

En endret helsestatus og endret sjukdomsbilde hos rein kan i noen tilfeller over tid kompenseres gjennom tilpasninger hos dyra, men kan også måtte tvinge fram endrede driftsrutiner i reindrifta. Ved opptreden av infeksjonssjukdommer hos rein, som for eksempel munn og klauvsjuke, som vi i dag ikke har og ikke ønsker verken hos rein eller husdyr, vil reindrifta bli gjenstand for utryddelsestiltak som kan få store og langvarige følger.

Will we have new diseases and health challenges in reindeer in the years to come?

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The Sami reindeer herding is based on traditional knowledge of reindeer as a herbivore that is able to exploit nature resources for meat production. In this way, the reindeer herding is dependent on the biology and health status of ecosystems, including climatic conditions. Reindeer herding has changed, from a nomadic/semi-nomadic structure to an increased degree of permanent housing and working hours, usually associated to increased efficacy and use of motorised vehicles. Such changes may also impact the status of health and diseases in reindeer. In addition to emaciation and malnutrition, including problems associated to supplemental feeding of reindeer, the infectious diseases are of most importance in the reindeer herding, and also these are changing. The bacterial disease necrobacillosis, that used to cause hoof problems and economical losses, has disappeared in that form, while some infections like contagious ecthyma, caused by a parapoxvirus, must be considered as a relatively new disease in reindeer.

The health condition and the presence of infectious diseases may change in three different ways in the future. First, new diseases and disease agents can be introduced into the reindeer population. This can be due to contact between domestic and wild animals with reindeer, through migration of reindeer across national borders or through import of live animals from regions where diseases such as brucellosis appears. Second, diseases may emerge or appear differently due to changes in the herding routines, such as increased supplementary feeding to avoid emaciation. By gathering animals in corrals and the use of troughs and other equipment, the animals will have increased contact which facilitates the transmission of infectious agents. Other relevant herding factors can be long transportations, between summer- and winter pasture and to slaughterhouse, or increased use of motorised vehicles. This may introduce stress, which may suppress the immune system of the animals and make them more susceptible to diseases. A third factor that may play a crucial role in the future is changes in climatic conditions. Increased precipitation and increased temperature variations are expected in reindeer herding regions. This may impact positively on some pasture plant species, but may also lead to increased icing and unavailable winter pastures. Climatic changes may represent changed conditions and survival of parasites, and insects that are vectors for parasites, bacteria and viruses may gain increased abundance and distribution. One example is the parasite *Setaria tundra*, which has shown a more northerly distribution during the past years, causing significant losses of reindeer meat at the slaughterhouses. The disease bluetongue in cattle, sheep and goats, caused by a virus having biting midges (*Culicoides* spp.) as vectors, is another example of a disease that can be relevant for reindeer in a long-term climate change scenario. Also blood sucking ticks (*Ixodes ricinus*) have had a more northerly distribution in previous years, and can be vectors of infectious agents for which reindeer are susceptible.

A changed health and disease status in reindeer may over time be compensated due to host adaptations, but may also force changes in how the reindeer herding is conducted in the future. If a diseases like foot and mouth disease, which we do not have and do not want in reindeer or domestic animals, should appear in reindeer, eradication campaigns will be launched, with expected huge short and long term impact on the reindeer herding.

Renskötseln och rovdjuren

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Dagens renskötsel påverkas starkt av många olika ingrepp och konkurrerande intressen. Rovdjurens påverkan skiljer sig från de flesta övriga genom att det drabbar djurresursen direkt medan de flesta övriga drabbar rennäringen via möjligheterna att använda land och bete. På grund av att renarna är en del av en näringsverksamhet är konsekvenserna av predationen annorlunda än när det gäller vilda bytesdjur.

I det nordiska området har de ökande stammarna av stora rovdjur utvecklats till ett synnerligen akut hot mot rennäringens fortbestånd. Genom direkta förluster av djur, skadad produktionspotential, minskade utrymmen för utveckling av djurmaterialet och försvårad markanvändning i kombination med påtvingat ökat skötselarbete och därmed ökade kostnader har ekonomin i renskötseln generellt blivit mycket pressad. I tillägg till detta skapar traumatiska upplevelser i frekventa möten med lemlästade och dödade egna och andras djur, ständig oro över den egna försörjningen och misstroenden och konflikter kring rovdjuren mycket starka sociala och psykiska obehag med ibland tragiska följder.

Förändringarna i rovdjurssituationen under de senaste åren har tveklöst redan initierat populationskollapser i många områden. I de södra delarna av finska renskötselområdet har det redan lett till både populationsmässiga och ekonomiska sammanbrott i renskötseln utlösta av vargförekomst. I mer nordliga områden i Finland är situation än så länge är hanterbar men försämras snabbt p.g.a. snabbt ökande förekomster av alla stora rovdjursarter. För svensk vidkommande pekar analyser av tillgängliga data mot en akut nära förestående eller redan är i ett påbörjat akut kollapsskede i den södra halvan (Västerbottens län och söderut) av renskötselområdet p.g.a. stora populationer av lo, järv och björn, medan Norrbottens län generellt sett ännu inte befinner sig i en akut hotsituation. Predationstrycket i Norge förefaller vara relativt måttligt i Finnmark men betydligt högre i speciellt i Troms och Nordland och även längre söderut i det samiska renskötselområdet framför allt till följd av ökande predation av lo, järv och kungsörn.

Uttalanden om rovdjurssituationen i renskötseln väcker ofta ifrågasättanden. Det är svårt att helt entydigt i alla detaljer visa hur ansträngd situationen i verkligheten är p.g.a. den stora inneboende variabiliteten och dynamiken i systemet och betydande ofullkomligheter i data och statistik kring rovdjuren och rennäringen. Till exempel är populationsskattningarna beträffande rovdjuren och deras påverkan tämligen genomgående underskattade p.g.a. metodmässiga brister och försiktighetsmässiga (och ibland uppenbart även av politiska) skäl. Renskötselstatistiken är också behäftade med ofullständigheter och fel, även om man vet betydligt mer om dem än om rovdjuren. Det är också stor variation i många vitala parametrar som behövs för att i detalj kunna utvärdera den aktuella situationen. Samstämmigheten i alla iakttagelser och resultat är dock så stor att det inte råder någon tvekan om att renskötseln generellt sett är mycket pressad av rovdjuren idag. Ett fundamentalt problem för renskötseln i detta sammanhang är också det låga vidkännandet och den ofta visade ignoransen och förnekandet av problemen i politiska led och samhället generellt.

Reindeer husbandry and the predators

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Reindeer husbandry of today is strongly affected by many different intrusions and competing interests. Depredation differs from most other in that it directly affects the animal stock, while others mostly act via the land and pasture resources. Since reindeer are a basis for a livelihood of people the consequences of the depredation are different from what is common with wild prey.

In the Nordic region the increasing populations of large predators have developed to an extremely acute threat against the sustainability of reindeer husbandry. Via direct losses of animals, damage of herd production capacity, reduced space for herd improvement measures and obstructions in use of grazing lands , as well as increase of management labor and costs, the consequences for the economy become generally very crushing. In addition, frequent traumatic experiences in meting injured and killed own and others animals, constant worries about the own sustainment and strong distrusts and conflicts connected to the predators cause immense social and mental discomfort with sometimes tragic consequences.

The developments of the predator situation during recent years have undoubtedly already initiated population collapses in many areas. In the southern parts of the Finnish reindeer herding area especially the expanding wolf populations has demonstrably caused population as well as economic collapses. The situation is still manageable in north, although rapidly worsening due to expanding bear, wolf, lynx and wolverine populations. Empirical results indicate that reindeer husbandry the southern half of the Swedish reindeer herding area (Västerbotten county and southwards) regionally appear to be in dynamic phases boding possible already ongoing collapses due to large populations of lynx, wolverine and bear, while reindeer husbandry in Norrbotten is not yet in acute danger although considerably affected. The depredation pressure in Norway seems fairly moderate in Finnmark county, but considerably higher in especially Troms and Nordland counties and also further southwards (except “tamreinlagen”, the Norwegian concession reindeer husbandry) due to increasing depredation by lynx, wolverine and golden eagle.

Statements about the predator situation in reindeer husbandry are often met by disputes. Clearly it is difficult to unambiguously in all details prove how vulnerable the situation actually is, due to the inherited dynamics and variability of the system and shortages in data and statistics. For example, predator population estimates and predation rates are quite consistently biased downwards due to methodological shortcomings and precautionary (and sometimes even political) reasons. Reindeer husbandry statistics is also affected by imperfections and incompleteness, although the knowledge is considerably more complete than that about the predators. In addition there are large variations and inaccuracies in many vital parameters needed in detailed evaluations of the situation. The consistency of signs and results is however so large that there is no doubt about that reindeer husbandry generally is strongly pressed by the depredation. A fundamental difficulty for the reindeer industries in this detta sammanhang är också det låga vidkännandet och den ofta visade ignoransen och förnekandet av problemen i politiska led och samhället generellt.

Sami herders' classification of reindeer pastures: An interdisciplinary contribution to the issue of forest management in winter grazing areas

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Over the last few decades, the use of forests both by Sami reindeer herders and for commercial forestry has been a source of increasing conflict in northern Sweden. Forestry modifies forest ecosystems and thus damages reindeer winter pastures, especially those rich in ground lichen. The results of an interdisciplinary study that comprised semi-directed interviews and participant observations will be presented. The objective was to understand the Sami reindeer herders' classification of winter pastures through their extensive ecological knowledge of forest pastures, and the characteristics they observe when managing this resource. This was done through the analysis of specific terminology and categories used by the Sami herders, to describe, analyse and communicate these properties. These terms, as well as Sami herder knowledge in general, emphasize the effects of forest structure and ground vegetation on variations in snow cover during the winter. For instance, whereas the western use of the word 'pasture' is often associated with a specific plant community, the Sami herders' understanding of the word also includes the effect of snow on grazing and for this they use a culturally specific word in their language: *guohtun*. This term is, like others terms, what authors in the field of ethnoscience call a complex category, i.e. a category defined by criteria belonging to different domains. Finally, by comparing herders' classification with the classification of forest vegetation currently used in forestry, the author argues that reindeer herders' categories convey the dynamic essence of reindeer winter pastures.

Ting skjer – et gløtt inn i bukkens taktikk under brunst

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Dette er primært historia om to "hotshots", bukkene "Spot" og "Mika" , og deres kamp for å føre sine gener videre under brunsten i 2007. "Spot" var seks år og veide 172 kg, mens " Mika" var fem år og hadde ei "matchvekt" på 141 kg før brunst. Sammen med 23 andre bukker (en 5-åring, to 4-åringer, tre 3-åringer, seks 2-åringer og 11 ett-åringer) kjempa de om gunsten til 87 simler innafor ett 15 km^2 stort hegn ved Kutuharju Feltforskningsstasjon for Reindrift, i Kamaanen, Finland. Konkurransen var hard og alle bukkene bidro, etter beste evne, til den turbulente og høgst dynamiske brunstperioden. Særlig "Hot", den tyngste av 4-åringene med ei vekt på 155 kg, spilte en sentral rolle – i tillegg til"Spot" og "Mika". Men som vi skal se – det er ingen snarveger til suksess, styrke og utholdenhet må kombineres med kløkt.

Shit happens – a glimpse into males' mating tactics in a polygynous ungulate – the reindeer

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This is about the two "hotshots", Spot and Mika, and their endeavour to propagate their genes during the mating season 2007. They were six and five years old, weighting 172 and 141 kg before rut, respectively. Together with 23 other males (one 5 yrs, two 4 yrs, three 3 yrs, six 2 yrs and eleven 1 yr old) they roamed within a 15 km^2 fenced area at Kutuharju Field Reindeer Research Station, in Kamaanen, Finland, competing for access to 87 females. Indeed, the competition was intense and all males present contributed to the dynamic observed. Especially Hot, the heaviest 4 yrs old male weighing 155 kg before rut, played a prominent role – in addition to Spot and Mika, their mating tactic being highly dynamic adapted to their rank and hence their fighting ability. However there is no short cut to success – strength have to be coupled with smartness, but shit happens - as we'll see.

Avklaring av beitebruk og beitekonflikter internt i reindriften, og rettslige forpliktelser på dette området

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I 1999 kom *Domstolkommisjonen* til at Grunnloven § 110 a stilte opp et ansvar for statens myndigheter til å ivareta hensynet til samisk språk, kultur og leveveger ved organisering av domstolene. For den samiske befolkningen i Finnmark er dette ansvaret generelt sett er langt på veg fulgt opp ved etableringen av *Sis-Finnmárkku diggegoddi/Indre Finnmark tingrett* i 2004.

For reindriftsutøverne, som utøver den kanskje mest spesifikke kulturbaserte samiske næringen, synes ikke dette ansvaret å være fulgt opp i tilstrekkelig grad. Bruken av vinterbeiteområdene i deler av Finnmark er preget av uklare rettsforhold, noe som både skaper konflikter, vanskelige arbeidsforhold og merkostnader for reindriftsutøverne. Dette kan igjen gå utover samisk kultur og leveveger. I dette foredraget vil jeg gå gjennom hvilket ansvar staten har for å opprette uavhengige organer som kan avgjøre rettstvister, fastlegge beiterettsgrenser og gi regler for beitebruk innen reindriften. Ansvaret vil bli vurdert både ut fra forpliktelsene i Grunnloven, folkeretten og reelle hensyn knyttet til dagens situasjon i reindriften.

Det vil også bli sett på hvilke prinsipper og rettsregler som bør legges til grunn for å avklare rettsforhold internt i reindriften.

Clarification of pasture rights and grazing conflicts within the reindeer husbandry and legal obligations in relation to that

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In 1999, the Courts Commission found that the Norwegian Constitution Article 110 a lined up a responsibility for Norwegian state authorities to safeguard the interests of the Sami language, culture and way of life in relation to organization of the courts. For the Sami people in Finnmark, this responsibility is generally followed up by the establishing of Sis-Finnmárkku diggegoddi / Inner Finnmark District Court in 2004.

For the reindeer herders that perhaps carry on the most specific Sami culture-based livelihood, this responsibility does not seem to be followed up adequately. The use of winter pastures in parts of Finnmark is characterized by an unclear legal situation, which both creates conflicts, difficult working conditions and additional costs for the reindeer herders. This could again make problems for the Sami culture and way of life. The problems to be addressed in this lecture is the responsibility the state has to create independent bodies to decide legal disputes, establish pasture boundaries and provide rules for grazing for reindeer herders. The responsibility will be evaluated both from the obligations of the Constitution, international law and policy considerations related to the current situation in reindeer husbandry.

The principles and rules of law which should be applied to clarify the legal relationships within the reindeer husbandry will also be examined.