



CAES Network
Circumpolar PhD Network in Arctic Environmental Studies

CAES Workshop

'Reindeer 2005'

28-29 August 2003, Saariselkä, Finland

in conjunction with the 11th Arctic Ungulate Conference

Programme & abstracts

CAES Workshop 'Reindeer 2005' 28-29 August 2003, Saariselkä, Finland Programme & abstracts

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Preface

Here we are again! Following a tradition that started four years ago in Tromsø, CAES will have a workshop 'Reindeer 2005' in conjunction with the 11th Arctic Ungulate Conference, in Saariselkä, Finland, 2003. The purpose of the workshop is to collect together PhD students, post-docs and senior scientists and to promote interdisciplinary discussion in studies relating to reindeer and reindeer husbandry.

The workshop was held last time in Tromsø 1999, in conjunction with the 10th Arctic Ungulate conference. In specific, the workshop 'Reindeer 2000' was a planning step and get-together for the international PhD course 'Reindeer as a keystone species in the north: Biological, cultural and socio-economic aspects' that was held in the northern Fennoscandia and Kola Peninsula in September 2000. During the workshop, important contacts were established and the course planning started. The course got very good responses and became a great success (The Proceedings are published in the Arctic Centre Reports 38, 2002).

The results of the course were so encouraging that CAES has decided to organise a similar course in 2005. There is still a high need for this kind interdisciplinary course in studies relating to reindeer husbandry. Similarly, there is clear need to bring students, scientists and herders together in the field and in real life situations in reindeer herding environment in the North like during the course 2000. The purpose of the Saariselkä workshop is to preliminarily get-together for the course 2005, and to start its planning. At the same time, this workshop aims to increase partnership between young natural and social scientists, and to foster interaction especially between the Nordic countries, North America and Russia.

During the workshop we will hear two acknowledged CAES actors as keynote speakers: CAES student Dessilav Sabev presents how he envisions an interdisciplinary approach to research being developed in his own field and studies and Dr. Katja Ruth presents an overview to current environmental situation on the Kola Peninsula. Students' presentations provide an overview of their proposed or ongoing studies. The workshop ends with a group session where the theme 'interdisciplinary' is discussed and future course is brainstormed and planned by the participants. Lively experiences from earlier courses will be provided by former CAES students.

The workshop is organised by CAES (Circumpolar PhD Network in Arctic Environmental Studies), and supported by NorFA.

All interested participants are warmly welcome!

August 2003

Päivi Soppela

Birgitta Åhman

Programme for CAES Workshop 'Reindeer 2005', in connection to the 11th Arctic Ungulate Conference 28-29 August 2003, Saariselkä, Finland

DAY 1

THU 28 August	14:00	Opening and presentation of CAES Network; Introduction to the Workshop <i>Päivi Soppela</i> , CAES Coordinator, Arctic Centre, University of Lapland
	14:20	Session 1, Chair: <i>Birgitta Åhman</i> Keynote lecture: "Who Studies Whom? Looking for a holistic approach on human/animal relationship in post-colonial North" <i>Dessislav Sabev</i> , Laval University, Québec, Canada.
	15:00	Short break
	15:10	Student presentations <i>Lotta Jaakkola</i> : Development of an adaptive management strategy in the reindeer husbandry area in Finland <i>Henrik Lundqvist</i> : Range suitability criteria for reindeer herding <i>Nikolay Polezhaev</i> : Resources evaluation of lands applicable to usage as reindeer ranges <i>Fiona S. Danks</i> : The future of reindeer habitat: using GIS and remote sensing to examine potential climate change impacts in the Nenets Autonomous Okrug and Barents Sea region
	16:20	Coffee break with sandwiches
	16:50	Student presentations <i>Berit Inga</i> : Traditional knowledge among reindeer herders: The essential parts of the knowledge about the ecology of reindeer <i>Heidi Kitti</i> : Defining the quality of reindeer pastures: The perspectives of Sámi reindeer herders <i>Satu Pohjola</i> : Measurement of milk intake and energy expenditure in reindeer calves with doubly-labelled water method <i>Jackie Hrabok</i> : Macroparasites of reindeer in Fennoscandia: parasite population dynamics, control options, and environmental impact implications
	18:00	Short break
	18:10	Student presentations <i>Kirill Istomin</i> : Epizootic outbreaks: a heavier burden on the Komi reindeer herding system than that of the Nenets? <i>Stephanie Lefrere</i> : Seasonal variations of reindeer activities and behavior in Finnish Lapland, Traditional and modern methods of management

	19:10	Summing up
	19:30	Closing
	20:00	Dinner

DAY 2

FRI 29 August	8:30	Session 2, Chair: <i>Päivi Soppela</i> Keynote lecture: "Current environmental situation on the Kola Peninsula", Dr. <i>Ekaterina Ruth</i> , Luleå University of Technology, Sweden
	9:10	Student presentations <i>Anna Skarin:</i> Impacts of topography, weather and tourist trails on reindeer habitat use <i>Andrei Marin:</i> At the Threshold of Order: Discourses on Reindeer Management in Sub-arctic Norway <i>Mark J. Dwyer:</i> Classification of pasture quality: Komi understanding and remote sensing <i>Larisa Semyunova:</i> Offers for cooperation between Yakutsk State Agricultural Academy and scientific and educational institutions of circumpolar countries <i>Kunniai Gagarina:</i> Experimental model of reindeer as a way to restore and develop the reindeer breeding in the Republic of Sakha (Yakutia)
	10.10	Coffee break
	10:30	Experiences from earlier courses <i>Robert Weladji</i> and <i>Sari Stark</i>
	10:50	Group workshop: plans and ideas for the course 2005
	11:30	Collecting the group work Summing up
	12:30	Closing the workshop (<i>Päivi Soppela</i>)

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Who Studies Whom? Looking for a holistic approach on human/animal relationship in post-colonial North (Keynote lecture)

Dessislav Sabev

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May we study reindeer? Is subsistence knowledge? Within which discipline? This paper explores some epistemological questions inspired by fieldwork in the Kola Peninsula, by witnessing co-management initiatives in the Canadian Arctic (Nunavik), by fieldtrips throughout Lapland, and by five-year participation in endless academic debates on traditional ecological knowledge (TEK). While sustainable development in the Arctic implies two different groups of human actors: scientific researchers and local communities, it becomes a contact zone between two incommensurable environments (“knowledge systems”): “the University” and what the latter has called “the field”. Hence, I open the discussion to the cultural construction of “knowledge”. Developing some concepts from a previous paper (CAES-2000), I criticize the western concept of “(scientific) discipline” which has been for a long time establishing methodological borders and reshaping environmental politics in the North in disregard to local knowledge. While the “field” offers a holistic perspective on environment, in West the science has become meaningful only as compartmentalized (Paul Nadasdy). In these terms, the scientific body has been disciplining everything it has been seeing (“studying”), projecting thus its internal political structure into the field. This relies on a colonial approach to the other (both human and environment) studied as object. Economic industrialization and political colonization of the Arctic have profoundly modified our relation to the animal. Approached as commercial product, the latter has been “objectified” by Western biologists in the same way that indigenous communities have been “studied” by anthropologists. Against the scientific discipline, my paper treats *Rangifer tarandus* as central actor (Tim Ingold) in the environmental, cultural and political dynamics. I argue that “interdisciplinary approach” implies a holistic, open to different knowledge systems, relationship to the environment (including humans). Finally, the paper encourages student’s participation in small and dynamic research centres and networks, working directly with local communities, instead of the heavy institutionalized Departments and Faculties of their Universities.

Development of an adaptive management strategy in the reindeer husbandry area in Finland

Lotta M. Jaakkola & T. P. Helle

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The aim of the present research is to provide knowledge of the arboreal lichen (*Alectoria spp.*, *Bryoria spp.*, *Usnea spp.*) resources for the development of the adaptive management approach in the reindeer husbandry area. As part of the planning of forestry the lichen resource data would facilitate the spatial and temporal distribution of forestry procedures in certain area and enable to minimise the disadvantages of cuttings for the reindeer husbandry. It would also enable a continuous monitoring and assessment of the impact of different land use policies.

At the first phase of the research, the biomasses of arboreal lichens were estimated in forests of different age, structure and arboreal lichen class. In order to specify the results of the abundance estimation method, correlation equations were created for the estimated biomasses.

Later the lichen biomass data together with the reindeer pasture inventory data from Finnish Forest Inventory, will be applied to model the correlation of the lichen abundance and stand characteristics. These models will provide information of the site requirements of the arboreal lichens and can be used to predict the impact of the changes in the forest structure on the lichen biomasses. The biomass models are then applied to create production functions for the forestry planning programs, in which case the important winter pastures will automatically be taken notice of in the forestry planning processes.

In the last part of the research the impact of the integration of reindeer husbandry and timber production on the regional economics is examined by using MELA2000 - optimisation programme. In the programme the impact of restrictions on the forest use and its economical consequences are calculated.

Range suitability criteria for reindeer herding

Henrik Lundqvist & Ö. Danell

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The Swedish reindeer herding area, with a north-south extension of eight latitude degrees and an east-west extension from Gulf of Botnia to the border mountains towards Norway, includes a large variation in reindeer husbandry conditions. The natural attributes for reindeer husbandry in this area could be characterized in terms of topographical and spatial properties of the land, features of the vegetation cover and patterns of climate and weather in conjunction. The topographical features in combination with climate particularly determine the properties of summer ranges via length of growing season, spatial and temporal distribution and quality of forage vegetation, and impacts of insect harassment. Winter ranges are to large extent synonymous with lichen ranges Length of snow covered season and snow depths together with incidences of ice crust formation determine the accessibilities and possibilities for sustainable management of lichen resources.

Possible criteria for range quality and suitability are developed from GIS-based topographic information, time series of weather data from 122 meteorological stations within the reindeer herding area and vegetation maps. The relevance of these criteria for describing variability in range suitability or capacity among the seasonal ranges of the 51 reindeer herding districts ($n = 51$) is analysed with multivariate ordination and clustering techniques. The results constitute a suggested minimum set of key criteria which retain the information about the variability in range suitability for reindeer husbandry in the total reindeer herding area, and by which discrimination among regions and individual herding districts could be done. The appropriateness of these criteria for explaining actual variation in herd productivities will later be correlated with herding district productivity data derived from population dynamic analyses of herd densities and production data.

Resources evaluation of lands applicable to usage as reindeer ranges

Nikolay Polezhaev

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Peculiarity of land usage in the Extreme North is their multifunction. The same territory can be used simultaneously for different purposes (reindeer ranges, hunting, fishing, edible and medicinal plant collecting, forage lands for live-stock). Value of lands is determined as a total income from all branches of traditional economic activity. Resource evaluation of territories of traditional economic nature usage is a complex of measures on revealing, inventory and estimation of stores of nature biological resources of lands. Methods on creation of informative-analytic system on resource evaluation of the territory of traditional nature usage is elaborated in laboratory of reindeer range ecology of Magadan Agricultural Research Institute. Severo-Evensk national district of Magadan region was selected as example. The main source in the field of evaluation of biological resources of reindeer ranges is the theme maps of scale of 1: 200000: map of seasonal reindeer ranges and the map of forage resources. Designation of the map of seasonal reindeer range is to show potential suitability of plots for reindeer herd grazing in different seasons. Designation of the forage resource map is to show forage stores and reindeer capacity according to seasons for each distinguished on the map polygon. Methods of preparation of digital large scaled economical geobotanical maps and connected with them data bases are elaborating in the Lab on the base of software ArcInfo and ArcView and hardware: computer, digitizer and scanner. GIS project "Typical project of reindeer range management of reindeer enterprise" was created on the base of land management materials of reindeer enterprise "Jubileinyi". Project includes digital map of reindeer ranges and database. Layers of graphic information contain data on hydrography, reindeer ranges, roads, fences, corals, huts, boundaries of enterprises, theplots of reindeer grazing. The map of reindeer range types and the map of seasonal reindeer ranges were created on the base of layer of polygons and attached database. Computerized technologies and special software allow owners of reindeer herds to keep in computer, analyze and use in economic process all necessary information on land ownership obtained as a result of land management work. Software allows to correct graphic information in the layers of digital map, add and change databases. Accumulation and analysis of new entering information on condition of forage and reindeer range resources are possible due to use of this technology.

The future of reindeer habitat: using GIS and remote sensing to examine potential climate change impacts in the Nenets Autonomous Okrug and Barents Sea region.

Fiona S. Danks & G. Rees

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Geographical Information Systems (GIS) and remote sensing techniques will be used to examine reindeer herding areas in the Barents Sea region and to model reindeer habitat, incorporating potential climate change. Semi-domesticated reindeer are a critical component of Arctic ecosystems: they influence the ecological balance and provide a way of life for peoples of the circumpolar Arctic. Over-grazing, shifts in land management and pressure for resource development threaten the sustainability of these traditional systems. Global climate change could further alter the situation. The key objectives of this research are to 1) provide information that will aid land management decisions, helping to ensure the sustainability of reindeer herding regions, and 2) to advance our knowledge and ability to respond to potential climate impacts. Analyses will be conducted on two scales. A general assessment of the Barents Sea region will be carried out on a coarse scale with reindeer herd numbers and locations described at the county/Oblast level as a minimum. A detailed analysis of reindeer habitat will be conducted in a specific area within the Nenets Autonomous Okrug in Russia at a fine scale. Habitat and ecological shifts, derived from modelled climate changes over a series of defined time scales, will be examined within the developed GIS database. Potential impacts on habitat and herding regions will be described. Methodology will consist of fieldwork and GIS and statistical analyses. Fieldwork will involve vegetation analyses, possible ground-truthing of remote sensing data, and research on reindeer land-use and herd composition details. Field, geophysical and other relevant data will be processed and analysed within the multi-layered GIS to create appropriate habitat models and maps. This research is prerequisite to understanding some of the stresses on Arctic ecosystems and is critical if we are to preserve the way of life and health of the reindeer herding regions.

Keywords: model GIS habitat climate-change

Traditional knowledge among reindeer herders: The essential parts of the knowledge about the ecology of reindeer.

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Traditional knowledge about how reindeer utilize forage resources is expected to be vital for reindeer husbandry. The investigation was carried out in four reindeer-herding districts (Sámi villages) in northern Sweden. Reindeer-herding Sámi, born in 1950 or earlier was interviewed about reindeer foraging on vascular plants, lichens and mushrooms. They were also asked to characterize a good winter grazing area. They especially recognised species that were used as food by the Sámi themselves, but also specific forage plants were identified. Among 41 plant species the informants identified altogether 21 plant taxa and five plant groups. Species recognised as fodder plants supported suggestions found in scientific literature. The reindeer herders had differentiating Sámi names for lichens, which generally described their appearance and the habitat they were found in. For mushrooms they only had one Sámi name. A good winter grazing area needs lichens, and the ground is preferably a dry *Pinus sylvestris* forest heath with old large trees with wide crown. Snow conditions are important; the lesser and smoother the snow on the ground is, the better. Places where reindeer herders know that snow tends to be problematic are used early in the winter (October – January). A conclusion is that the detailed knowledge on plant level was surprisingly scarce, considering that the range resources are of vital importance in pastoral systems as reindeer herding, and in sharp contradiction to the detailed knowledge the Sámi express on for example reindeer or snow conditions. The suggested explanation is that the plant species information is unnecessarily detailed information in reindeer pastoralism.

Keywords: lichens, mushrooms, pastoralism, Sámi language, snow, grazing

Defining the quality of reindeer pastures: The perspectives of Sámi reindeer herders

Heidi Kitti, N. Gunsley & B. Forbes.

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Biologists have studied the reindeer pastures of Northern Fennoscandia since the beginning of the 20th century. Recent studies have provided the basis of the current management plan for the reindeer herding area, which essentially dictates the number of reindeer allowed per district/decade. Reindeer herders have been critical of this practice because they feel this provides one-sided picture of the state of the pastures and that their expertise remains undervalued and unexploited, both in terms of practical planning and the relevant legislation. We investigated how reindeer herders define the pastures, in part to involve local people in the research and thus to value their knowledge. We interviewed 25 reindeer herders in Finland and Sweden during the years 2001 and 2002. We also took part with them in their daily work as a form of participant observation. The main themes of the interviews and field observation centred on the management of pastures, classification of the pastures, and land use. The primary indicator for the condition of the pastures derives from observations of the condition and behaviour of reindeer. When there is a state of *heajos guohtun* (bad condition of pastures in Sámi language) the condition of the animals gets worse. Factors affecting the pastures are divided by herders into environmental (biological, geographical and climatic) and anthropogenic (socio-economic, legal and cultural) factors. These factors are often coexistent and changing both in time and space. For example, the term *heajos guohtun* can mean many things; like snow conditions, disturbance, predator threats, location or vegetation. This research provides an opportunity to enhance studies, which rely primarily on vegetation and soils to indicate the quality of the pastures. Our aim is that these different types of knowledge could be evaluated in the search for a more complete understanding of the pastures.

Keywords: traditional ecological knowledge, *Rangifer tarandus*, reindeer management

Measurement of milk intake and energy expenditure in reindeer calves with doubly-labelled water

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Milking of reindeer has been studied extensively. The data on milk output is primarily based on the milking experiments. Milking includes separation of the calves from their mothers. However, it is well-known that free suckling by the calf continuously stimulates milk production of the mother. To get information about lactation in mammals with minimal handling and disturbance, techniques based on the use of physiological tracers have been developed and used in several species. For example, use of doubly-labelled water has become common in measuring water turnover and energy consumption in mammals, also in ruminants like reindeer.

Doubly-labelled water (DLW, $^2\text{H}_2^{18}\text{O}$) includes non-toxic, non-radioactive isotopes of hydrogen and oxygen. The DLW method offers good possibilities for the measurement of milk production in reindeer. Mothers and calves can be kept together during the experiment. The output of labelled water through dispersion and excretion and the input of new, non-labelled water through drinking, eating and metabolism allows for the dilution of ^2H and O^{18} in the body. Since O^{18} is also lost as carbon dioxide the O^{18} loss curve is steeper than the ^2H , and the difference between the two curves is a measure of the carbon dioxide produced by the body. Water turnover can be calculated from the dilution curves of the isotopes, and the amount of milk consumed by calves can be calculated through water turnover. The assumption is that the calf gets majority of the water from milk.

The objective of the present research was: (1) to study undisturbed milk production of reindeer mother through milk intake of their calves using DLW method, and (2) to study energy expenditure of the calves using DLW. In addition, milk energy and energy expenditure of the calves will be compared, and the effect of mothers' milk production on the body weight gain of the calves will be evaluated. The field work conducted in 4 reindeer mothers and 4 calves in May and June 2003 at the Kaamanen Reindeer Research Station, in Finnish Lapland. Known amounts of DLW were given to calves and their dilution was measured through blood samples. Two experiments were conducted in reindeer calves at two different ages: at about 7 days and 21 days. Each measurement lasted 7 days. Blood samples were collected at days 2, 5 and 7. The samples are analyzed by mass spectrophotometry. Mothers were fed high-protein feed concentrates during the experiment. Daily, individual feed intake of mothers was recorded by computerised feeding collars. After the measurement period, mothers were milked empty with a milking machine (with oxytocin) and the amount of milk produced per day was calculated.

Preliminary results show that body weight gain of the calves was very rapid, or 160-470 g day⁻¹ during first and 300-460 g day⁻¹ during second experiment. The results of the isotopic measurements of milk intake are yet not available. The amount of milk produced by the mother by milking varied a lot between individuals. The milk output was 880-1800 g day⁻¹ in the first experiment, and 520-1740 g day⁻¹ in the second experiment.

Macroparasites of reindeer in Fennoscandia: parasite population dynamics, control options, and environmental impact implications

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With the aim of determining the seasonal dynamics, impact, and identification of the best time for treatment intervention, a long-term (2002–2005) study has commenced on the gastro-intestinal and pulmonary nematode parasites of semi-domesticated reindeer at the Kaamanen Reindeer Research Station and Kutuharju Experimental Station in northern Finland (69° N, 27° E). The population dynamics of roundworms is being monitored by monthly faecal egg counts in two age classes of reindeer and by estimating the pick-up of infective larvae from the grazing environment by the sequential use of 4 worm-free ‘tracer’ reindeer calves, every 8 weeks. Since June 2002, the mean number of nematode eggs·g⁻¹ faeces (mEPG) was higher in calves (mEPG=57) than in adult female reindeer (mEPG=29). Female calves (mEPG=62) excreted more eggs than male calves (mEPG=46). In adult animals, *Capillaria* spp. was prevalent in December (mEPG=120), although it was not detected in June 2002 or February 2003. *Ostertagia* spp. eggs were ubiquitous in adults, with a major peak in September (mEPG=90). Nematodirinae were not detected in adult reindeer. *Capillaria* spp, *Ostertagia* spp, and the Nematodirinae were present every month in calves, although mixed infections were rare. *Capillaria* was most abundant in December (mEPG=103), *Ostertagia* in September (mEPG=88), and the Nematodirinae in November (mEPG=97). From November 2002 through February 2003, tracer tests illustrated that larval pickup from pasture was highest in November (mean=343) and lowest in February (mean=100). Male calves harboured marginally more nematodes than female calves (mean nemas = 276 vs. 229). The predominant taxa were *Ostertagia* spp of the abomasum and the Nematodirinae of the small intestine. A previously unreported feature of these infections is the high level of inhibition of the early fourth larval stage of development, suggestive of a survival mechanism to enable the parasite to escape adverse environmental conditions in the external environment.

Keywords: Faecal egg counts, tracer calves, gastro-intestinal nematodes

Epizootic outbreaks: a heavier burden on the Komi reindeer herding system than that of the Nenets?

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Diseases such as *sirbika* (Siberian anthrax) have in the past been responsible for significant disruption of Komi reindeer herding, even forcing herders to abandon infected land. We compared the frequency and intensity of epizootic outbreaks among reindeer herded by Komi and Nenets in Russia. We examined, in particular, whether higher incidence of disease among Komi herds might be related to differences in herding practices between the two groups, especially the Komis' unusually long and narrow migration corridors and large herd sizes. The Komi migrate up to 1,000 km in a nine-month period whereas the Nenets remain more sedentary and move very little for long periods in each season. Our analysis was based on herders' knowledge and published empirical data. Komi reindeer suffer higher incidence of disease and higher rates of mortality from disease compared to Nenets reindeer. It appears that long migrations may (a) weaken reindeer and (b) make it more difficult for herders to identify sick animals and (c) to treat them adequately. Moreover, Komi herders have few options for avoiding poor pastures because they are obliged to move along traditional migration routes over which particular families have more or less exclusive rights. Consequently, they are rarely able completely to avoid ground infected by *sirbika* for the recommended two to three year period following an outbreak, which was a significant problem prior to the availability of inoculations. Despite the higher levels of mortality from disease in Komi herds, there appears to be little difference in overall rates of loss (death and other losses) between the two groups.

Seasonal variations of reindeer activities and behaviour in Finnish Lapland Traditional and modern methods of management

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This abstract summarizes the monograph done during my PhD. This consists first in the analysis of the annual activities cycle and social interactions between reindeer through seasons under natural conditions in pasture but also purely experimental in corral, with the variations in their feeding behaviour. Reindeer were thus studied from birth to weaning with the analysis of the mother-calf bond until their separation and consequences on suckling behaviour and milk yield. Then from summer to the beginning of winter, females' activities and their food selection were studied in a pasture. During the rut, I investigated the changes in males' behaviour associated to their level of testosterone. Finally, in wintertime, the development of the hierarchy and changes in activities of females related to their cardiac rhythm was completed. The second part of the thesis compares the traditional and modern methods of reindeer management, with the different utilization of reindeer. My work shows how human has succeeded to control the rules of a partial domestication by adaptation of the reindeer in its environment.

Keywords: activities, cardiac rhythm, feeding behaviour, human, management, milk, rut and social interactions.

Current environmental situation on the Kola Peninsula

(Keynote lecture)

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Before the 20th century the population of the Kola Peninsula was mainly engaged in fishing, hunting and reindeer herding. With building of the railway from St. Petersburg to Murmansk in 1916 and research expeditions in 1920s, intensive industrialisation of the region became possible. The geological expeditions organised by the Russian Academy of Sciences resulted in discovery of large deposits of apatite, copper-nickel and iron ore, which lead to the beginning of commercial exploitation of the deposits, construction of mining and processing enterprises.

However, industrialisation of the Murmansk Region resulted not only in positive economic development; it caused severe environmental problems as well. According to AMAP report (1997), areas severely affected by air pollution around Nickel - Pechenga and Varanger increased from 400 km² in 1973 to 5000 km² in 1988; lichen-dominated area on the Kola Peninsula decreased during the same period from ca 3000 km² to 500 km².

Atmospheric emissions, produced mostly by major industrial units in the region, Severonickel and Pechenganickel, are still among the most significant in Europe, while some positive changes are on the way. The governor of the Murmansk Region, Yuri Evdokimov, has reported on 28.07.2003 (<http://gov.murman.ru/reports/rep-018.shtml>) that reconstruction of the enrichment department of the Pechenganickel plant has started in 2001. It is expected that when the new facilities start running in 2006, the sulphur dioxide emissions will be reduced with more than 90%.

At the same time new potential hazards are awaiting. In 2003 the Russian Government decided to project a pipeline in the Murmansk Region for transporting Siberian oil to the ice-free port in Murmansk (<http://www.murman.ru>). An oil terminal, with capacity of 5.4 million ton oil per year, has been built this year in Kola Bay (<http://gov.murman.ru/reports/rep-018.shtml>).

Impacts of topography, weather and tourist trails on reindeer habitat use

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Habitat use of reindeer is assumed to depend on factors such as the time of the year, availability of forage, and disturbances by insects, humans and predators. Habitat selection can be viewed as a hierarchical process whereby animals make selection decisions at progressively smaller spatial scales (Senft *et al.*, 1987, *BioScience*, 37, 789-799). Habitat use of semi-domesticated reindeer (*Rangifer tarandus tarandus*) was investigated through faecal pellet-group counts and by direct observations of reindeer from helicopter in the Långfjället area in Idre reindeer herding district (62°10'N) and in Mittådalen reindeer herding district (62°50'N, only aerial observations). Pellet-group densities were related to altitude, distance to tourist trails and vegetation type and the aerial observations were related to weather. The aim was to examine to which degree habitat use was affected by these factors. The reindeer pellets were found to be most abundant in habitats at high altitudes, but there was no preference found for any special vegetation type. The pellet-group density tended to be higher near the tourist trails, which tended to follow higher altitudes in the terrain. The aerial observations of reindeer showed that the reindeer moved towards higher altitudes when the wind speed was low and the temperature was high both in June and July in both study areas. In June they also responded in the same way in both areas and walked towards lower areas when temperature was low and the wind speed was strong. High densities of pellets found on summits may therefore have been a result of reindeer seeking relief from insect harassment and/or to thermo-regulate at places where the wind speed is higher during calm and warm weather. One reason why preferences could not be detected for any particular vegetation type at Långfjället may be that the area is relatively homogenous and that several vegetation types, usually regarded as preferred, were missing or rare. The conclusion is that the reindeer use Långfjället to escape insect harassment and warm weather since it's the only place within their summer range where they easily can reach higher grounds.

At the Threshold of Order: Discourses on Reindeer Management in Sub-arctic Norway

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Nomadic pastoralism is characterised by flexible patterns of resource use and tenure regimes, as a response to fluctuating circumstances. In sub-arctic Norway, traditional tenure and resource-use regimes of Saami reindeer pastoralism have been replaced by a formalized system reinforced by the State. Today the lichen ranges are highly degraded and the enterprise is sustained by large subsidies, legitimating more control from the Administration and calling for a drastic revision of management approach. Using the framework of political ecology and narrative analysis, the present study addresses the environmental, economic, social and institutional impacts of the present management regime on the common winter ranges in Inner Finnmark. The article contrasts the discourse of the herders with the two meta-narratives produced by the hegemonic discourse of the State and reproduced by society at large: a single, optimum stocking density as a prerequisite for sustainable production; and a need for centrally-controlled, formalised regulation system in order to avoid resource degradation. The paper discusses the received wisdom, simplification, methodological flaws and vested interests inherent in this approach as illustrated by herders' narratives and supported by secondary empirical evidence and scientific theories that acknowledge the influence of various circumstances (climatic, social, economic, cultural) upon the production strategy of the herders. An opportunistic management approach that develops and legitimates local institutions to coordinate the use of common ranges according to ecological variability and customary tenure system is proposed as an alternative.

Keywords: carrying capacity, discourse, overgrazing, political ecology, rangeland management.

Classification of pasture quality: Komi understanding and remote sensing

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Komi reindeer herders have a detailed conceptual picture of their spring, summer, and autumn pastures. Different areas are recognised and classified in terms of their suitability for particular functions in herding. The herders' conceptualisation of pasture quality in these seasons seems to approximate to a classification in which good pastures are areas in which habitat diversity, in terms of physical structure and vegetation, is high whereas poor pastures are areas where the habitat is more homogeneous. The herders have no equivalent classification of their winter pasture areas. Instead, some areas are recognised as being generally good (and different herding groups may compete for access) whereas other areas are generally avoided. In this project, satellite remote sensing is used to compare the physical characteristics of 'good' and 'poor' pasture in areas used by the Komi in winter.

Offers for cooperation between Yakutsk State Agricultural Academy and scientific and educational institutions of circumpolar countries

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In educational area:

- training courses on reindeer breeding on the basis of the experimental reindeer reserve Tabsylyn
- courses of studies Veterinary medicine , Technology of agricultural manufacture and processing on the production base of YSAA
- courses on reindeer fur and leather processing on the base of YSAA, with the assistance of College of design technologies and traditional crafts, Arctic Institute of Culture, reindeer breeding communities and enterprises of Yakutia
- courses and seminars on tourism on the basis of economic department of YSAA, with the assistance of Ministry for Youth Policy, Ministry for Entrepreneurship and tourism, and organizations concerned
- exchange of students and academics under the project of Arctic Council, Northern Forum, Finland Development of modern manufacture and technology of produce processing (We would like to thank the organizers and coordinators of the project: Arctic Council, Northern Forum Secretariate, Educational Centre of Lapp region, and personally Mr Lassi Valkiepa.)
- participation of teams from circumpolar countries in annual reindeer breeders Games
- participation in exhibitions of agricultural equipment and traditional crafts

In scientific research area:

- joint projects on fundamental studies of animals acclimated to the Far North
- joint development of scientific recommendations on the selection of perennial pasture herbs and the application of bioactive substances, physical factors improving the progeny of seeds
- creation of effective preparations of reindeer dags, manufacture of medicines and prophylactics on the basis of the local herbal and animal material
- joint development of the systems of monitoring and prophylaxis of agricultural animals diseases
- production of the cycle of popular science TV programmes devoted to the problems of reindeer breeding, the traditional culture and crafts of circumpolar countries, the scientific projects of research institutions, the projects of Northern Forum and other organizations
- joint scientific projects on anthropology, culturology, sociology, philosophy, economics.

Experimental model of reindeer as a way to restore and develop the reindeer breeding in the Republic of Sakha (Yakutia)

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The reindeer has been part of life for the people of Yakutia since ancient times. It is the major source of meat, clothing, material for national crafts, the important vehicle for reindeer breeders and hunters. Demand on dietary reindeer meat, endocrine material and reindeer by-products for manufacturing bioactive ferment and hormonal preparations has increased lately.

Since 1981 to 2000 the livestock of reindeer in the Republic of Sakha (Yakutia) decreased more than twice. Reindeer breeding has now vanished in nearly all of the taiga regions of central Yakutia.

We are convinced that restoration and development of reindeer breeding in the taiga regions is the reserve resource for increase and productivity of reindeer livestock.

There are vast restored reindeer moss pastures in taiga, which are not used in agricultural production and allow to feed up to 100 thousand reindeers with no damage to natural resources.

The main aim of "Tabsalyn", the experimental reindeer and Yakut horse reserve to be created, is the economic evaluation of reindeer breeding in the taiga regions. To obtain the aim, the following tasks are to be solved:

- to create the optimal model of family-operated reindeer farm and to distribute the experience in central Yakutia by 2010;
- to transfer part of reindeer into private property in the long term, to shift reindeer breeders to sedentary life, and to facilitate their social conditions by introduction of advanced technologies.

Expected results of the project:

1. To obtain scientifically proved results of the acclimatization of experiment reindeer kept in fencing in local conditions.
2. To create the model of reindeer farm for 500 reindeers operated by a family consisting of 3 or 4 members, with the help of YSAA.
3. The model must meet modern social requirements, must possess optimal infrastructure and mobile energy source and own means of production.
4. To obtain economical results of scientific research and to apply them to manufacture, to distribute the experience of reindeer breeding in the taiga regions.
5. The results of the given project will help to solve the problems of employment of indigenous population which can keep in private property up to 100 thousand reindeers. That will allow to increase the general livestock of reindeer and to stabilize the branch of reindeer breeding in the Republic of Sakha (Yakutia).

The aim of work and the practical purpose of estimated results:

The project is aimed at the creation of experimental reindeer farm model with the livestock up to 500 head and with the complete infrastructure. By the end of 2003 we will have biochemical measurements of experiment reindeer blood and milk, production of meat and endocrine raw material.

The application of estimated results:

Distribution of the experience of family-operated reindeer farm in the taiga regions of Yakutia, employment of about 500 representatives of indigenous population, increase of reindeer livestock up to 100 thousand.

According to the project, the gross production of reindeer breeding will increase three times, including procurement and sale of dags, antler breakage, endocrine and ferment raw material, and other produce.

Qualifications of the executor of the project:

Since 1997 YSAA have been carrying out experiments on studying genophenotypic adaptation of Evenk reindeer in the conditions of central Yakutia. For the first time the technology of manufacture of biological products from thymus has been developed.

The experimental results made the basis for monographs by L.N.Vladimirov and I.S.Reshetnikov "Reindeer breeding situation and ways to increase commodity output", "Reindeer thymus".