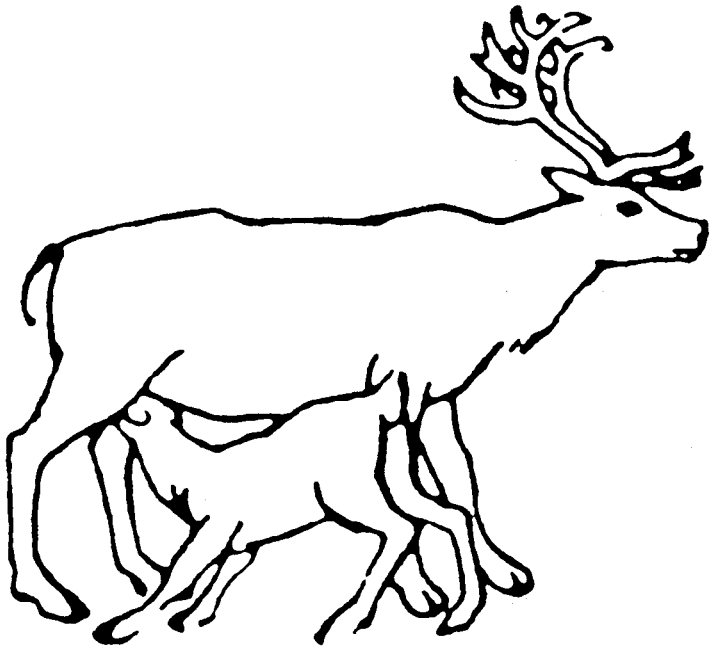
NOR:n 11. pohjoismainen porotutkijakokous
Den 11. nordiske forskningskonferansen
om rein og reindrift
The 11th Nordic Conference on Reindeer Research
Kaamanen, Finland, 18-20 June 2001

Ohjelma ja lyhennelmät
Program og sammendrag
Programme and abstracts



RANGIFER

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Nordisk Organ for Reinforskning (NOR)/Pohjoismainen Porontutkimuselin ble etablert i 1980 og har vedtekter vedtatt av Nordisk Ministerråd (landbruksministrene) i 1992. Organet er et samarbeidsorgan mellom Finland, Norge, Sverige og Grønland med formål å fremme utvikling og samordning av rein- og reindriftsforskningen til nytte for reindriftsnæringen i de nordiske land. Virksomheten finansieres ved direkte bidrag fra deltakerlandene.
Nordic Council for Reindeer Research (NOR) was founded in 1980 to promoting cooperation in research on reindeer and reindeer husbandry. From 1993 the organisation is under the auspices of the Nordic Council of Ministers (the Ministers of Agriculture). The work of NOR depends on funds from the member governments (Finland, Norway, Sweden and Greenland).

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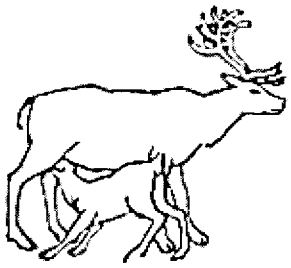

PROGRAM OG SAMMENDRAG

PROGRAMME AND ABSTRACTS

Den 11. nordiske forskningskonferansen om rein og reindrift

The 11th Nordic Conference on Reindeer Research

Kaamanen, 18-20 juni 2001

RIISTAN- JA KALANTUTKIMUS

Redaktør/Editor: Rolf Egil Haugerud

Nordisk Organ for Reinforskning (NOR), Nordic Council for Reindeer Research
Vilt- och fiskeriforskningsinstitutet, Renforskningsstationen RKTL, Kaamanen
Finnish Game and Fisheries Research Institute, Reindeer Research Station, Kaamanen

Tromsø 2001

Järjestely / Organisering / Organisation

NOR:n järjestely- ja ohjelmatoimikunta
NORs organisasjonskomité og programkomite
NOR's Organising Committee and Scientific Programme Committee

Öje Danell, Uppsala
Rolf Egil Haugerud, Tromsø
Mauri Nieminen, Kaamanen

Paikallinen järjestelytoimikunta
Lokal arrangementskomité / Local Organising Committee

Mauri Nieminen
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Den 11. nordiske forskningskonferansen om rein og reindrift
The 11th Nordic Conference on Reindeer Research

Kaamanen, RKTL Reindeer Research Station, 18-20 June, 2001

Ohjelma / Program / Programme

Maanantai/Mandag/Monday, 18. juni

Saapuminen/ankomst/arrival

Før/ Before1800	Registrering/registration (på/at Kievari)
1800	Buss fra Kievari (via Hopiampi) til Enare/Bus from Kievari (via Hopialampi) to Inari.
1930	Mottakelse-åpning av utstilling på Samemuséet/Reception-opening of exhibition at the Sámi museum.
2200	Returbuss til Kievari/Return bus from Inari to Kaamanen.

Postere settes opp på RKTL reinforskningsstasjonen så snart som mulig på mandag og på tirsdag i pausene.

Tiistai/Tirsdag/Tuesday, 19. juni

Pääteema: Porojen ruokinta
Hovedtema: Fóring av rein
Main topic: Artificial feeding of reindeer

0800	Buss til den finske reinforskningsstasjonen/Bus to Hopialampi reindeer research station
0830-1000	Ordstyrer/Session leader: **Rolf Egil Haugerud** NOR
0830	Kokouksen avaus/Åpning av konferansen/opening of the conference **Mauri Nieminen**, forskningsleder RKTL/Reseach leader RKTL

Kutsutut ja muut pääteemaesitelmät / Inviterte foredrag og andre foredrag innen hovedemnet / Invited lectures (I) and other lectures (O) within the main theme
I tidsoppsettet er inkludert tid til spørsmål/The time table includes questions.

0845	I - **Storeheier, P. V.,** S. D. Mathiesen & M. A. Olsen. Reinens vinterernæring – fôrinntak og beitekvalitet / Winter nutrition in reindeer – food intake and forage quality.

0915 I - **Åhman, B.** & Ö. Danell. Utfordring av renar - möjligheter, effekter och ekonomi / Reindeer feeding – possibilities, effects and economy.

1000-1030 Kaffe/Coffe - Posteroppsetting

1030-1230 Ordstyrer/Session leader: **Pekka Huhtanen** MTT/Jokioinen

1030 I - **Maijala, V.** & M. Nieminen. Porojen talviruokinta - kokemuksia ja tuloksia Suomesta / Winter feeding of reindeer - experiences and results from Finland.

1115 I - **Huhtanen, P.** Märehtijän ravitsemuksen kvantitatiivinen tarkastelu / Quantitative aspects of digestion in ruminants with special referance to reindeer.

1200 I - **Soveri, T.** Ruokinnan vaikutukset poron pötsiin / Effects of feeding on rumen of reindeer.

1230 Lunsj/Lunch (På stasjonen)

1330-1435 Ordstyrer/Session leader: **Päivi Soppela** Arctic Centre

1330 I - **Oksanen, A.** Poron ruokinta ja terveys / Reindeer feeding and health.

1415 O - **Tryland, M.,** T. D. Josefsen & A. Oksanen. Smittsom munnskurv – en fôringsrelatert sjukdom hos rein / Contagious ecthyma – a disease related to feeding of reindeer.

1435-1500 Kaffe/Coffee. Posteroppsetting.

1500-1605 Ordstyrer/Session leader: **Birgitta Åhman** SLU

1500 I - **Nieminen, M.** & V. Maijala. Ruokinta ja poronlihan koostumus / Feeding and chemical composition of reindeer meat.

1545 O - **Wiklund, E.** Effekter av utfodring på renköttets kvalitet / Effects of feeding on the quality of reindeer meat.

1605-1700 Spørsmål / diskusjon / Questions / discussion

1715 Buss til Kevari / Bus to Kievari

1730 Badstu i Kievari / Sauna in Kievari

1900 Juhlaillainen/Konferansemiddag/Conference dinner (Kaamasen Kievari)

Keskiviikko/Onsdag/Wednesday, 20. juni

0815 Buss til reinforskningsstasjonen/Bus to Hopialampi reindeer research station

Muut esitelmät / Foredrag utenom hovedemnet / Lectures in other topics

0845-1200 Ordstyrer/Session leader: **Bror Saitton** Sametinget i Sverige

0845 **Riseth, J. Å.** Fra overskudd til underskudd på vinterbeitekapasitet - Hvordan kan vi forklare utviklinga i Vest-Finnmark reinbeiteområde, Norge, 1960-2000? / From excess to lack of winter pasture capacity-how can we ecplain the development of West Finnmark Reindeer Pasture Area, 1960-2000?

0920 **Waller, P.,** A. Oksanen, M. Nieminen & O. Halvorsen. Poron loiset Fennoskandiassa – populaatiodynamiikka, torjuntakeinot ja niiden ympäristövaikutukset / Macroparasites in semi domesticated reindeer of Fennoscandia – Parasite population dynamics, control options, and environmental impact implications.

Tauluesitykset / Plakater / Postere

Sesjon/Session: **Fysiologia / Fysiologi / Physiology**

0940 Sesjonssammendrag/Overview of session posters: **Päivi Soppela**

1000 Kaffe/Coffe
og/and Postersesjon/Poster session

Sesjon/Session: **Laidun ja ruokinta / Beite og fóring / Pasture and feeding**

1100 Sesjonssammendrag/Overview of session posters: **Jouko Kumpula**

1120 Postersesjon/Poster session

1200 Lunsj / Lunch (På stasjonen)

1300-1615 Ordstyrer/Session leader: **Mauri Nieminen** RKTL

Sesjon/Session: **Tuotanto / Produksjon / Production**

1300 Sesjonssammendrag/Overview of session posters: **Öje Danell**

1320 Postersesjon/Poster session

1400 Kaffe / Coffee

Sesjon/Session: **Sairaudet ja terveys / Sykdom og helse / Health issues**

1420 Sesjonssammendrag/Overview of session posters: **Timo Soveri**

1440 Postersesjon/postersesjon

1520-1600 Spørsmål / diskusjon / Questions / discussion

1600 Avslutning/Concluding the conference
Innbydelse til neste NOR konferanse, mars 2002

1615 Buss til Kievari / Bus to Kievari

INFO - The 11th Nordic Conference on Reindeer Research

Programme: see the preceding pages
Time: June 18-20, 2001
Locality: Kaamanen. RKTL Reindeer Research Station, Hopialampi, Finland

Kaamanen is 32 and 70 km north of Inari and Ivalo (E-75) respectively, and 90 km from Karasjok (road no. 4). Kaamasen Kievari Inn is situated some few kms south of the crossroads mainroad no. 4 and E-75 Rovaniemi/Utsjoki. The distance from Kievari to RKTL research station is 12 km (reached by E-75 to small crossroads about 10 km south of Kievari and 2-3 km along west sideroad from E-75). Transports from Kievari to research station and vice versa, see the programme.

Registration
The registration is at the Kievari Inn on Monday before departure to reception (1500-1800), and later when appropriate.

Accommodation
Rooms/cabins are booked at Kaamasen Kievari Inn. Here you will have breakfast on Tuesday and Wednesday, and Conference Dinner on Tuesday evening. Lunch and coffee on Tuesday and Wednesday are served at the RKTL research station.

Payment
Participants cover all their own expenses for travel, accommodation and other costs. Payment (also invited speakers) is done directly to the Kaamasen Kievari Inn before you leave the conference.

Presentations and conference languages
The main theme "Artificial feeding of reindeer" will be presented by invited lecturers in Scandinavian (Norwegian or Swedish) and Finnish, with simultaneous translation. In addition there will be some lectures in English. The posters (in four different topic sessions, see programme) are mainly in English. The abstracts (see Rangifer report, distributed at the registration) of all the presentations are in English and Finnish/Norwegian/Swedish).
Normal equipment for presentations will be available (slide- and overhead projectors, white board, data equipment). The posters should be put up as early as possible.
To ensure best possible translation, speakers should provide manuscripts/overhead - and slide texts no later than 14 June, 2001.

Proceedings
Manuscripts of lectures in Scandinavian/Finnish (Tuesday) should be ready before the conference (see the paragraph above). Hopefully they will be published in a proceedings issue of Rangifer report together with popularized material from posters. However a proceedings issue will depend on sufficient number of contributions.
Full scientific manuscripts in English of original articles and brief communications from either oral or poster presentations will be considered for publication in ordinary issues of Rangifer following to peer review. Such articles will be marked as originally presented at the 11th NOR conference.

Telephone and telefax
Numbers to the research station are: phone 020 5751 820 and fax 020 5751 829. You will find info about Kievari at the web-site www.kaamasenkievari.fi

Lyhennelmät / sammendrag / abstracts

Pääteema: Porojen ruokinta
Hovedtema: Fóring av rein
Main topic: Artificial feeding of reindeer

Kutsutut ja muut pääteemaesitelmät
Inviterte foredrag og andre foredrag innen hovedemnet
Invited lectures (I) and other lectures (O) within the main theme

Muut esitelmät / Foredrag utenom hovedemnet / Lectures in other topics

Beregninger av fôrinntaket til frittgående reinsdyr om vinteren

Pål Vegar Storeheier[1], Svein D. Mathiesen[2] & Monica A. Olsen[1]

[1] Department of Arctic Biology and Institute of Medical Biology, University of Tromsø, N-9037 Tromsø, Norway.

[2] Department of Arctic Veterinary Medicine, The Norwegian School of Veterinary Science, N-9292 Tromsø, Norway.

Dette studiet ble påbegynt for å måle fôrinntaket til frittgående tam rein (*Rangifer tarandus tarandus*) seint om vinteren i Finnmark, Norge. Fôrinntaket ble beregnet indirekte ved hjelp av målinger av møkkproduksjon og beregninger av diettens fordøyelighet. Tre rein kalver (10 måneder) ble opplært til å ha på seg spesiallagde møkksamlere under kontrollerte betingelser ved Avdeling for Arktisk Biologi, Universitetet i Tromsø. Dyrene ble gitt krom oksid (Cr_2O_3) kapsler (Captec, Laverton, Australia) oralt. Disse blir liggende i vomma og frigir en konstant mengde Cr_2O_3 per dag. Reinsdyrene ble deretter satt ut i en frittgående flokk som gikk på vinterbeite i Finnmark. I en seksdagers periode i mars 2000 hadde dyrene på seg møkksamlere som ble tømt en gang per dag. Innholdet av krom oksid i den innsamlede møkka blir nå analysert. Da dyrene ble slaktet ved forsøksslutt dominerte vedaktige planter (35%) og lav (32%) den botaniske sammensetningen i vomma, mens kun små mengder gressaktige planter (13%) og mose (6%) ble funnet i vomvæsken. Dyrenes gjennomsnittlige, daglige produksjon av møkk var 315.4 g tørrstoff (TS) eller 8.6 g TS · kg^{-1} kroppsvekt. Hvis man antar at dyrene fordøyde gjennomsnittlig 60% av tørrstoffet i de plantene de spiste, vil dette tilsvare et gjennomsnittlig daglig fôrinntak på 788.6 g TS eller 21.5 g TS · kg^{-1} BM. Disse foreløpige resultatene indikerer at TS inntaket til våre frittgående rein var lik TS inntaket til rein som står på bås og som blir gitt fri tilgang til pelletert reinfôr om vinteren.

Voluntary food intake in free-ranging reindeer in winter

The present study was initiated to estimate the food intake in free-ranging semi-domesticated reindeer (*Rangifer tarandus tarandus*) in late winter in Finnmark, northern Norway. Food intake was estimated indirectly using measurements of faecal production and estimates of forage digestibility. Three 10 months old reindeer calves were accustomed to wear faeces collecting bags under controlled conditions at the Department of Arctic Biology, University of Tromsø. The animals were given intraruminal chromic oxide (Cr_2O_3) controlled release capsules (Captec, Laverton, Australia) orally and subsequently released into a reindeer herd freely grazing on their winter pastures in Finnmark. During a period of six days in March 2000, the reindeer were fitted with faeces collecting bags that were emptied once a day. The chromic oxide content of this faeces is currently being analysed. When the animals were slaughtered at the end of the experimental period, woody plants (35%) and lichens (32%) dominated the botanical composition in their rumen, whereas only minor amounts of graminoids (13%) and mosses (6%) were present in the rumen fluid. The mean daily dry matter (DM) faecal output of the animals was 315.4 g DM or 8.6 g DM · kg^{-1} body mass (BM). Assuming a mean digestibility of the forage plants eaten by reindeer in winter of 60% DM yields a mean daily food intake 788.6 g DM or 21.5 g DM · kg^{-1} BM. These preliminary results suggest that the DM intake in our experimental free-ranging animals were equal to the DM intake in captive reindeer fed *ad libitum* amounts of a pelleted reindeer feed in winter.

Utfodring av renar - möjligheter, effekter och ekonomi

Birgitta Åhman & Öje Danell
SLU, Reindeer Husbandry Unit, Department of Animal Breeding and Genetics, P.O. Box 7023, S-750 07 Uppsala, Sweden.

Utfodring av renar har blivit allt vanligare under senare år. Renar utfodras under längre perioder för att undvika stor dödlighet och för att bibehålla eller förbättra djurens fysiska kondition under vintern eller för att uppnå högre kroppsvikter före slakt. I Sverige utfodras också 7000-8000 renar per år för att sänka halterna av radioaktivt cesium före slakt. I det senare fallet betalar staten ersättning till renägaren för de kostnader som utfodringen medför. Kostnaderna är annars relativt höga i förhållande till den förväntade vinsten i form av ökad produktion - fler överlevande renar och fler vajor som producerar kalvar eller tyngre renar vilka ger mer kött per djur.
Vi har beräknat utgifter och avkastning vid utfodring av ren i olika situationer, exempelvis utfodring av kalvar och ungdjur före slakt, utfodring av hela vinterhjorden under vintern och utfodring av vajor under våren. Utgifterna, i första hand betalning för foder, stängsel, transporter och arbete, är relativt lätta att beräkna. Vinsten däremot beror mycket på den produktivitet som skulle uppnås om renarna hölls bara på naturligt bete, och är därmed beroende av en mängd omgivningsfaktorer, som inte kan uppskattas med enkla metoder. Vår slutsats är dock att utfodring, använt rutinmässigt i renskötseln, bara är lönsam i speciella situationer. Att hålla betena i bra kondition genom att anpassa renhjorden till betenas produktivitet och optimera hjordstrukturen är ekonomiskt effektivare än långa perioder med kompenserande utfodring. Situationen blir annorlunda ur ekonomisk synpunkt om syftet är att rädda djur under enstaka år med exempelvis extrema snöförhållanden.

Reindeer feeding - possibilities, effects and economy

Feeding of reindeer has been getting more common during recent years. Reindeer are fed for longer periods either to avoid excessive losses and preserve or improve the physical condition of the animals in the in the winter, or to achieve higher body weights before slaughter. In Sweden, 7000-8000 reindeer per year are also fed to reduce the levels of radioactive caesium in the body before slaughter. In the latter case the reindeer owners are compensated by the state for the cost of feeding. The costs are, otherwise, relatively high compared to the expected yield in terms of improved production, either as more reindeer surviving and producing calves or heavier reindeer producing more meat per animal.
We have calculated the costs and benefits of feeding reindeer in different situations, e.g. feeding of calves and yearlings before slaughter, feeding the whole winter herd during winter, and feeding breeding females in the spring. The expenses are mainly costs for feed, fences, travel and labour and are thus relatively easy to calculate. The yield, on the other hand, very much depends on the productivity that would be obtained if the reindeer were kept only on natural pastures and thus depends on a number of environmental conditions that are not assessed very easily. However, we conclude that feeding, as routine in reindeer management, is profitable only in special situations. Keeping the pastures in good condition by adapting stocking rate to the productivity of the ranges and optimising herd structure are economically a more effective ways to improve the productivity in the reindeer heard than long periods of compensatory feeding. The situation is different from economic point of view when the purpose is to save animals during occasional years with e.g. extreme snow conditions.

Porojen talviruokinta - kokemuksia ja tuloksia Suomesta

Veikko Maijala & Mauri Nieminen
Riista- ja kalatalouden tutkimuslaitos, Porotutkimusasema, FIN-99910 Kaamanen, Finland.

Porojen talviruokinta aloitettiin Suomessa 1970 luvun alussa. Ensin poroja ruokittiin vain huonoina vuosina. Suomessa porojen lisä- ja tarharuokinta aloitetaan viimeistään silloin kun, kaivuolosuhteet vaikeutuvat ja porot eivät saa enää riittävästi rehua luonnonlaitumelta. Eräissä poronhoitoalueen paliskunnissa lähes koko porokarja pidetään talvisin tarharuokinnassa. Vain muutamassa paliskunnassa lisäruokintaa ei harjoiteta juuri lainkaan. Poronhoitoalueen eteläosissa poroja ruokitaan pääasiassa tarhaan, keskiosissa tarhaan ja maastoon ja pohjoisosissa pääasiassa maastoon. Suomessa maastoruokinnan yleisimmät rehut ovat heinä, säilörehu ja teollinen täysrehu. Rehua varataan riittävästi ruokintaa varten, niin ettei se lopu talven aikana kesken. Maastoruokinnan ideana on korvata se ravinnon määrä, jota poro ei saa luonnosta ravinnontarpeensa tyydyttämiseen. Lisäruokinnassa poro saa annetusta rehusta ainoastaan osan päivittäisestä ravinnontarpeestaan, loppuosan se saa luonnonlaitumelta. Tarharuokinnassa poro saa kaiken ravintonsa annettavasta rehusta. Suomessa tarharuokinnassa käytettävät aidat ovat niin isoja, että poroilla on jatkuvasti saatavilla puhdasta lunta. Sairaille ja heikoille poroille varataan oma aitaus. Porotarhassa on myös niille poroille oma aitaus, jotka tuodaan tarharuokintaan muita myöhemmin. Metsästä tuodut porot totutetaan omassa aitauksessa tarharuokinnassa käytettäviin rehuihin. Aina kun porolle annetaan sellaista rehua, mitä se ei ole aikaisemmin saanut, on poro totutettava syömään sitä. Tottuminen ruokinnassa käytettäviin rehuihin kestää 2-3 viikkoa. Tarharuokinnassa porojen kuntoa ja käyttäytymistä seurataan päivittäin. Jos poro ei ruokinta aikana tule syömään, niin silloin tarkistetaan syy syömättömyyteen. Onko poro sairas vai kylläinen ja on märehtimässä. Poroille annetaan rehua hieman enemmän kuin niiden ylläpitotarve vaatisi. Näin pyritään varmistamaan porojen hyvä kunto.

Tuloksia Paliskuntain yhdistyksen porokoetarhalta Kaamasesta

Talvella 1999 tutkimuksessa oli neljä ryhmää: 1) normiruokinta aitaukseen teollisella täysrehulla (PH; Poronherkku, Rehuraisio, 1,5 kg/poro/vrk), 2) maastoruokinta (0,9 kg PH/poro/vrk), 3) luonnonlaidun, 4) rehua vapaasti saatavilla (PH) (ympärivuotinen ruokinta) (vaatimet söivät 2,9 kg ja vasat 2,7 kg/poro/vrk).

Normi- ja maastoruokinnassa olleiden vasojen keskipainot pysyivät koejakson (21.1.1999-28.4.1999) ennallaan (45 kg). Luonnonlaitumien varassa olleiden vasojen painot laskivat 45 kg:sta 36 kg:aan. Vapaasti rehua saaneiden vasojen painot nousivat 54,5 kg:sta 57,1 kg:aan. Normi- ja maastoruokittujen vaatimien painot eivät muuttuneet koejakson aikana (79 kg). Luonnonlaitumien varassa olleiden vaatimien painot laskivat 79 kg:sta 70 kg:aan. Vapaasti rehua saaneiden vaatimien painot pysyivät 86 kg ja 89 kg välillä. Kaikissa ryhmissä porojen kunto pysyi hyvänä, paitsi luonnonlaitumella olleiden porojen kunto heikkeni. Luonnon-laitumien varassa olleiden vaatimien vasat olivat syntyessään keveämpiä (5,3 kg) kuin maastoruokinnassa olleiden vaatimien vasat (6,4 kg). Pienimmät vasat olivät kuitenkin normiruokinnassa olleilla vaatimilla (5,1 kg). Vapaasti täysrehua saaneiden vaatimien vasat painoivat 6,1 kg. Saadessaan syödä rehua vapaasti (ympärivuotinen ruokintaryhmä) porot söivät lähes kaksinkertaisen inäärän normiruokintaan verrattuna. Ympärivuotisessa ruokintaryhmässä ilmeni myös ongelmia koejakson jälkeen mm. keuhkotulehdusta.

Winter feeding of reindeer - experiences and results from Finland

Veikko Maijala & Mauri Nieminen
Finnish Game and Fisheries Research Institute, Reindeer Research Station, Fin-99910 Kaamanen, Finland (veikko.maijala@rktl.fi).

In Finland feeding of reindeer was started in the beginning of the 1970s. At first reindeer were fed only during poor winters. In Finland the winter supplementary feeding and fence feeding begins usually when the circumstances for digging are so poor that reindeer don't get sufficiently forage from underneath the snow. There are some herding co-operatives in Finland where all reindeer are fed during winter. On the other hand, there are only few herding co-operatives, which don't practice winter feeding at all. In the southern parts of the Finnish reindeer husbandry area reindeer are fed in the fences in wintertime, in the central parts both in fences and at terrain, and in the northern parts mostly at terrain. The most common forages in terrain feeding are dry hay, silage and commercial pellets. Reindeer herder must reserve forage enough for the feeding, because it is important that the forage doesn't run out during the winter. The idea of terrain feeding is that the supplemental forage compensates insufficiently or inaccessibly available natural forage. In terrain feeding the reindeer get their daily foodstuff partly by given forage and partly from the natural pasture. In fence feeding the reindeer get their entire food by given forage. In Finland the fences have to be large enough that reindeer have a possibility to eat clean snow at anytime. Own fences are reserved for ill and weak reindeer. There are also own fences for reindeer, which are brought later in winter. Those reindeer, which are transported straight from the forest, are put in to their own fence where they get used to eat supplemental forage. Every time a reindeer is introduced with a new forage, feeding has to be started carefully allowing reindeer to adapt to the new diet. It takes at least 2-3 weeks to get used to new forage. During the fence feeding period health and behaviour of reindeer are observed daily. If the reindeer doesn't come to eat at feeding times, reindeer herder must check why it doesn't come. Is the reindeer sick or is it just satisfied and ruminates? To maintain weight balance during feeding reindeer are usually offered energy slightly in excess to their physiological needs This is one way to assure good condition in reindeer.

Results from the Experimental Field Station of the Reindeer Herders' Association in Kaamanen

During winter 1999 we had four feeding gronps: 1) norm feeding with commercial reindeer pellets (PH; PoronHerkku, Rehuraisio, Finland) in the fence (1,5 kg/reindeer/day, 2) feeding at terrain (0,9 kg PH/reindeer/day), 3) terrain without any supplemental food (natural grazing) and 4) PH *ad lib.* (year around feeding)(adults ate 2,9 kg and calves 2,7, kg/reindeer/day).

During feeding in the fence and feeding at terrain weight of calves remained quite stabile through experiment period (21.1-28.4.1999), 45 kg. Calves without any supplemental food at terrain lost weight from 45 to 36 kg. Calves fed commercial pellets *ad lib.* gained weight from 54 to 57 kg. Also weights of adult females remained stabile (79 kg) when fed in fence or terrain. During natural grazing without any supplemental food females lost weight from 79 to 70 kg. In *ad lib.* feeding they maintained weight between 86-89 kg. The condition of reindeer remained good throughout the experiment in all groups except in the group without any supplemental food. Highest birth weights of calves were obtained in the group with supplemental feeding at terrain (6,4 kg). The birth weights of calves in the groups of *ad lib.* feeding in fence, in terrain without any supplemental food and norm feeding in fence were 6,1 kg, 5,3 kg and 5,1 kg, respectively. When reindeer were offered *ad lib.* diets, they ate almost double amount compared to norm diets. There were also some problems in year around feeding groups after experiment period, e.g. cases of pneumonia.

Märehtijän ravitsemuksen kvantitatiivinen tarkastelu

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Märehtijöiden ruoansulatus ja aineenvaihdunta poikkeaa muista eläimistä. Hiilihydraattien sulatus perustuu pötsin mikrobisulatukseen, jonka lopputuotteina ovat haihtuvat rasvahapot (VFA). Mikrobit saavat fermentaatiosta energiaa kasvuunsa ja pötsistä virtaava mikrobimassa onkin märehtijöiden tärkein valkuaisen (aminohappojen) lähde. Haihtuvat rasvahapot, joita pötsin lisäksi muodostuu jonkin verran umpi- ja paksusuolessa, muodostavat keskimäärin noin 70% imeytyneen energian määrästä. Vastaavasti mikrobivalkuainen muodostaa samoin noin 70% imeytyneistä aminohapoista, joskin osuus vaihtelee rehuvalkuaisen pötsihajoavuuden erojen vuoksi enemmän kuin VFA:n osuus energian saannista.

Märehtijöiden ekologinen lokero ihmisravinnon tuottamisessa perustuu niiden kykyyn sulattaa tehokkaasti solunseinähiilihydraatteja ja muodostaa mikrobivalkuaista yksinkertaisista typellisistä yhdisteistä. Nämä eivät kuitenkaan tapahdu ilman tappioita, vaan hiilihydraattien käymisessä syntyy energiatappioita metaanin ja käymisenergian muodossa ja hyvälaatuista valkuaista voi imeytyä pötsistä ammoniakkina, joka myöhemmin menetetään virtsaan ureana. Näiden tappioiden vuoksi märehtijät käyttävät viljan ja valkuaisrehujen ravintoaineet huonommin hyväkseen kuin yksimahaiset tuotantoeläimet.

Märehtijät jaetaan käyttämänsä rehun perusteella kolmeen pääryhmään: laiduntajat l. karkearehun käyttäjät (1), valikoijat (2) sekä välityypin märehtijät, joiden ruokintastrategia voi vaihdella vuodenajan mukaan. Nauta on tyypillinen laiduntaja ja hirvi puolestaan valikoija. Poro luetaan välityypin märehtijäksi. Karkearehun käyttäjillä on suurempi ja kehittyneempi pötsi, ohutsuoli on pitempi ja umpi- ja paksusuoli suhteessa pienempi kuin valikoijilla. Valikoijilla puolestaan on kehittymättömämpi pötsi, mutta suuremmat sylkirauhaset ja kehittyneet pötsin papillit neutraloivat pötsin happamuutta tehokkaasti, mikä on välttämätöntä rehun koostuessa valikoiduista nopeasti sulavista kasvin osista. Välikoijilla on suurempi umpi- ja paksusuoli kuin laiduntajilla, mikä osittain kompensoi tehottomampaa karkearehun sulatusta pötsissä.

Erityisesti karkearehujen käyttäjien etumahat ovat kehittyneet tehokkaaseen kuidun hyväksikäyttöön. Viipymisaika on pitkä, esim. lypsylehmillä noin 40 tuntia. Pitkän viipymisajan vaikutusta tehostaa edelleen rehun välikoiva viipyminen, ts. rehun poistuminen pötsistä ei ole satunnaista. Partikkeleiden poistumistodennäköisyys pötsistä riippuu niiden koosta ja ominaispainosta. Märehtimisen seurauksena pötsissä olevat partikkelit pienevät, jolloin ne voivat helpommin virrata satakertaan ja sieltä juoksutusmahaan. Partikkeleiden ominaispaino on jopa kokoa tärkeämpi virtausta säätelevä tekijä. Nuorissa partikkeleissa on ruusaasti fermentoituvaa materiaalia, jolloin käymisessä muodostuva kaasu pitää ne kelluvina. Tällöin partikkelit pysyvät pääasiassa pötsin selän puoleises sa pussissa eivätkä virtaa pötsistä. Käymisen jatkuessa kaasun muodostus vähenee, jolloin partikkeleiden ominaispaino lisääntyy. Tällöin ne siirtyvät verkkomahaan ja edelleen satakertaan. Valikoivan viipymismekanismin avulla märehtijät pystyvät maksimoimaan energian saannin: sulavaa materiaalia sisältävät partikkelit pysyvät pötsissä ja vastaavasti pitemmälle sulaneet virtaavat ulos, jolloin tulee tilaa syödä uutta rehua.

Märehtijöillä ruoansulatuskanavasta imeytyneen glukoosin määrä on hyvin pieni. Sokeri muodostuu maksassa pääsiassa propinihaposta ja osaksi aminohapoista. Maidontuotantoon tarvitaan runsaasti sokeria (lehmä n. 70 g/kg). Porot vasovat toukokuussa, jolloin rehun saanti ei vastaa tarvetta ja maidontuotantoa joudutaan ylläpitämään osaksi kudosvarastojen turvin. Kudosvarastot riittävät parhaiten rasvan, huonointen laktoosin tuotantoon. Tästä syystä poron maito sisältää runsaasti energiaa ja valkuaista suhteessa laktoosiin, jonka turvin vasa kehittyy riittävästi käyttämään hyväkseen runsaimman ravinnon saannin luonnosta alkukesän aikana.

Quantitative Aspects of Digestion in Ruminants with Special Reference to Reindeer

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Digestion and metabolism in ruminant are in many aspects different from simple-stomached animals. Carbohydrates are digested by microbes in the rumen and absorbed as volatile fatty acids (VFA). Carbohydrate fermentation provides energy for microbial protein synthesis in the rumen. Microbial protein synthesis is related to the amount of organic matter fermented in the rumen (25 - 30 g N/kg OM apparently fermented). VFA, which are also produced in the hind-gut, provides about 70% of digestible energy. Microbial protein provides about 70% of amino acids absorbed from the small intestine. Variable degradability of feed protein influence the contribution of microbial protein of total protein supply to the animal.

Ecological niche of ruminants in human food production is based on their ability to digest cell wall carbohydrates and synthesize high quality microbial protein from non-protein N. This does not take place without losses. In rumen fermentation a proportion of energy (15 - 20%) is lost as methane and fermentation energy. Utilisation of high quality protein is lower because of ammonia absorption and conversion of amino N to RNA and DNA N.

Ruminants can be divided into three main groups on the basis of their feeding strategy: grazers or roughage eaters (1), concentrate selectors (2) and intermediate feeders, which can change their strategy according to feed availability and season. Bovine is a typical grazer and moose a concentrate selector, whereas reindeer is an intermediate feeder. Grazers have a larger and more developed rumen, a longer small intestine and relatively smaller hind-gut than concentrate selectors. The latter have less developed and smaller rumen, but their salivary glands and rumen papillae are more developed than in grazers to maintain rumen pH. Concentrate selectors have also relatively larger hind-gut, which partially compensates for reduced cell wall digestion in the forestomachs.

Especially grazers are efficient in cell wall digestion and utilization. Long retention time of feed particles in the rumen (e.g. dairy cows about 40 h) facilitates high digestibility of potentially digestible cell walls. The efficiency of digestion is further improved by selective retention of feed particles in the rumen, i.e. the outflow of particles is not a random process. Probability of particles to escape from the rumen depends on their size and specific gravity. Particle size decreases in rumination, and particles > 2 mm seldom flow out from the rumen. Specific gravity of particles is even more important than size in determining the probability to flow out to the omasum and further to abomasum. In recently ingested particles active microbial fermentation produces small gas bubbles, which attach to particles thereby increasing their buoyancy. Later, when the particles contain less fermentable substrate, gas production decreases and specific gravity increases. Heavy particles sink down from the mass and are therefore more likely to escape from rumen fermentation. Mechanism of selective retention allows both efficient cell wall digestion and high intake, which are both necessary to maximise energy intake from forages.

The amount of glucose absorbed from the small intestine of ruminants is generally small, although large amounts are needed for milk production (co w 70 g/kg). Glucose is produced mainly in the liver with propionate and amino being the most important substrates. Reindeer calve in May, when the feed supply is limited. Under these circumstances a large proportion of nutrients are derived from body reserves. Body tissues provide well nutrients for milk fat, but are rather limited for lactose. In reindeer milk lactose content is low in relation to fat and protein. This allows a supply of energy and protein to the calf from body reserves during the first weeks to develop enough to use the good quality pastures in early summer.

Ruokinnan vaikutukset poron pötsiin

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Etumahakäymisen tarkoituksena on mikrobien avulla pilkkoa kasvien muuten vaikeasti sulavia rakennehiilihydraatteja ja näin saada niihin sidottu energia poron käyttöön. Samalla mahdollistuu korkealuokkaisen valkuaisen synteesi yksinkertaisista typpiyhdisteistä. Etumahoista pötsi on tilavuudeltaan suurin ja toiminnaltaan merkittävin. Siellä bakteerit, alkueläimet ja sienet pilkkovat poron nielemää ravintoa. Hiilihydraattien mikrobikäymisen lopputuotteena syntyy haihtuvia rasvahappoja, jotka muodostavat yli 2/3 poron tarvitsemasta energiasta. Suurin osa pötsissä muodostuvista haihtuvista rasvahapoista imeytyvät pötsin seinämän läpi verenkiertoon. Pötsin seinämän limakalvo on muodostunut pötsinystyistä koostuvasta pötsinukasta, joka moninkertaistaa imeytymispinta-alan. Pötsinukan tärkein tehtävä onkin tehostaa haihtuvien rasvahappojen imeytymistä ja toisaalta haihtuvat rasvahapot ovat tärkein pötsinukkaa kasvattava tekijä. Mitä enemmän haihtuvia rasvahappoja muodostuu, tiettyyn rajaan asti, sitä pitemmiksi ja paksummiksi pötsinystyt kasvavat. Vastasyntyneellä vasalla etumahat ovat hyvin pieniä ja pötsin limakalvo on aivan sileä. Pienet vasat ovatkin yksimahaisia, niiden imemä maito kulkee märekourua pitkin suoraan juoksutusmahaan, eikä etumahoissa ole vielä toimintaa. Vasa alkaa kuitenkin jo ensimmäisen elinviikkonsa aikana hamuta pieniä määriä kiinteää ravintoa. Näin se saa etumahoihinsa mikrobeja ja etumahojen pienelöstö alkaa kehittyä. Samalla pötsissä alkaa syntyä pieniä määriä haihtuvia rasvahappoja ja myös pötsinukka alkaa nopeasti kehittyä. Ensimmäisen elinviikon aikana ei nystyjä vielä ole, mutta jo 3-viikkoisella vasalla ne ovat kohtalaisen kehittyneet. Kahden kuukauden ikäistä vasaa voidaan pitää jo täysin märehtijänä. Yhden-kahden kuukauden ikäisen vasan pötsin imeytymispinta-ala/cm^2 vastaa puolen vuoden ikäisen vasan pinta-alaa. Sen pötsinystyt ovat lyhyempiä ja ohuempia, mutta niitä on enemmän. Pötsinukka kehittyy täysimittaiseksi vasta toisena kesänä; ensimmäisenä talvena vasan pötsin imeytymispinta-ala on alle puolet aikuisen eläimen vastaavasta. Pötsinystyjen koko ja pötsimikrobisto sopeutuvat tietyissä rajoissa käytettyyn ravintoon, sen laatuun ja määrään. Jos ravinnossa on paljon helposti sulavia hiilihydraatteja, muodostuu pötsissä paljon haihtuvia rasvahappoja ja pötsinystyt kasvavat. Vastaavasti kuitupitoisella ravinnolla pötsinukka pienenee. Liian kuitupitoisen rehun annon seurauksena poro saattaa nälkiintyä, väikka ravintoa määrällisesti olisikin riittävästi. Koska pötsimikrobiston ja pötsinukan sopeutumiseen uuteen ravintoon kestää suunnilleen saman ajan, noin 2-3 viikkoa, tulee tämä aika aina varata ruokintamuutosten vähittäiseen toteuttamiseen. Jos helposti sulavia hiilihydraatteja sisältävää ravintoa, esim. väkirehua, tarjotaan eläimelle joka ei ole siihen tottunut tai eläin pääsee syömään sitä ylenmäärin, muodostuu pötsissä nopeasti paljon haihtuvia rasvahappoja. Pötsi happamoituu ja kehittyy pötsiasidoosi, joka voi johtaa jopa eläimen kuolemaan. Vastakkainen tila syntyy jos poro syö paljon valkuaista tai ureaa ja erityisesti jos rehu on pilaantunutta. Pötsin sisältö muuttuu emäksiseksi ja kehittyy pötsialkaloosi eli emäksinen pötsi, jonka oireena on usein ripuli. Nälkiintyminen vaikuttaa pötsiin monin tavoin. Sen sisältö muuttuu vetiseksi ja pH nousee. Pötsin seinämän lihakset vähenevät, joka aiheuttaa pötsin liikkeiden heikkenemistä. Pieneliöstön lajimäärä pienenee, sekä lukumäärä ja tilavuus vähenevät. Tämä laskee mikrobikäymisen kokonaistehokkuutta. Pötsinukka pienenee, joka heikentää haihtuvien rasvahappojen imeytymiskapasiteettia. Nälkiintynyttä poroa tuleekin ruokkia varovaisesti: pieniä määriä useasti sellaista ravintoa mihin se on tottunut.

Effects of feeding on rumen of reindeer

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The purpose of fermentation in the forestomach of reindeer is, with the aid of microbial digestion, to make the structural carbohydrates of plants available for use as energy. At the same time it becomes possible to synthesize proteins of high quality from simple nitrogen compounds. The rumen is the largest and most important part of the forestomach. Bacteria, protozoa and fungi digest nutrients, that have been swallowed by the reindeer. The volatile fatty acids (VFAs) formed as the end product of microbial fermentation of carbohydrates constitute over 2/3 of the energy used by the reindeer. Most of the VFAs formed in the rumen are absorbed through the rumen wall into circulation. The mucosal membrane of rumen contains ruminal papillae that multiply the absorption surface area. The most important function of these papillae is to increase the efficiency of absorbtion of VFAs, which in turn are the most important growth factors for papillae. The more VFAs are formed, to a certain limit, the longer and thicker papillae grow. The forestomach of the newborn reindeer calf is very small and the ruminal mucosa is even. Small calves have a simple stomach. Milk sucked by them goes via the oesophageal groove to the abomasum, and there is no function in the forestomach. The calf begins to eat small amounts of solid feeds even during the first week after birth. In this way microbes enter the forestomaeh and the microbial flora begin to develop. At the same time small amounts of VFAs are formed and the papillae begin their rapid development. By the age of 3 weeks the papillae are fairly well developed and at the age of 2 months the calf is a real ruminant. The ruminal absorption surface area/cm^2 ruminal wall of a calf aged 1-2 months corresponds to that of a 6-month-old calf. The papillae are shorter and thinner, but there are more of them. Papillae develop during the second summer to full size. During their first winter the calves have a ruminal absorption surface area that is half of that of the adult reindeer. The size of the papillae and ruminal microbes adapt within certain limits to foods consumed, and to their quality and quantity. If the diet consists of large amounts of easily digestible carbohydrates, a large amount of VFAs form in the rumen and the papillae grow. With a diet rich in cell wall carbohydrates (e.g. cellulose) the papillae get smaller. Feeding reindeer with feeds rich in cellulose can result in starvation, even if the amount of food is otherwise sufficient. Because the adaptation of both rumen microbial flora and papillae takes about the same time, approximately 2-3 weeks, changes in the diet should also take this amount of time and be made step by step. If a reindeer suddenly receives feed that is rich in easily digestible carbohydrates, large amounts of VFAs are formed quickly in the rumen. An acid rumen can develop, which can be fatal. The opposite situation occurs when a reindeer eats feed rich in proteins or urea, particularly if the feed is spoilt. An alkaline rumen develops, often followed by diarrhoea. Starvation has many effects on the rumen. Its contents become watery and pH increases. Muscles in the wall of rumen decrease, which weakens its movements. The number of species of microbes decreases, as do their total number and volume. This weakens the efficiency of microbial digestion. Papillae get smaller, which decreases the absorption capacity of VFAs. Food should be given to a starved reindeer carefully: small amounts often, and feeds which the reindeer is used to.

Poron ruokinta ja terveys

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Tärkein syy poron talviruokintaan on tarve turvata eläinten henki, terveys ja tuottavuus, ja elinkeinon kannattavuus.

Vaikka yleensä talviruokinta täyttää tehtävänsä ja edistää porokarjan terveyttä, huonosti suoritettu ruokinta toisaalta myös aiheuttaa sairautta. Poro on ravintonsa valikoiva märehtijä, jonka etumahat talvella sopeutuvat energiapitoisen jäkälän käyttöön. Karkea korsipitoinen rehu, vaikka sopisikin lehmälle ja lampaalle, ei sula poron pötsissä tarpeeksi nopeasti, mikä johtaa aliravitsemukseen. Nälkään kuolleiden porojen ruumiinavauksessa voidaan joskus löytää pötsi pullollaan sulamatonta karkeaa heinää.

Toisaalta liian helposti sulavan väkirehun, tai esimerkiksi leivän, käyttö poron ruokinnassa ei ole ongelmatonta sekään. Liian äkkinäinen ja/tai runsas väkirehun saanti johtaa hengenvaaralliseen pötsin happamoitumiseen, mistä kuolema voi seurata alle puolen vuorokauden kuluessa.

Myynnissä oleva heinä tai säilörehu on lisäksi joskus laadultaan heikkoa ja jopa homeista. Homesieniä on tuhansia lajeja, joista monet tuottavat myrkkyjä. Homemyrkkyjä tunnetaan niitäkin satoja erilaisia yhdisteitä. Niiden vaikutukset elimistössä ovat moninaiset; ne voivat vaurioittaa esim. maksaa, munuaisia, keskushermostoa, limakalvoja tai immuunipuolustusta. Eräät homemyrkyt aiheuttavat ruuansulatushäiriöitä, toiset syöpää ja jotkut vaikuttavat sukupuolihormonien kaltaisesti, aiheuttaen keskenmenoja. Kaikki selkärankaiset eläimet ovat myrkyille alttiita, mutta myrkkyjen aiheuttamat vauriot ja oireet vaihtelevat lajikohtaisesti. Poron herkkyys homemyrkyille on vielä heikosti tunnettu, mutta viimeaikaisissa tutkimuksissa on havaittu, että porot mahdollisuuksien mukaan välttelevät homeisia jäkäliköitä. Heikosti olisivat asiat, jos porot kerättäisiin tarhaan, missä ne saisivat yksinomaiseksi talviruoaksi karkeaa ja homeista heinää.

Hyvälaatuinen ja oikein annosteltu rehukaan ei aina takaa ruokinnan terveellisyyttä. Muutaman tarttuvan taudin on viime vuosina havaittu olevan yhteydessä tarharuokintaan. Osittain yhteys selittyy tarkkailulla. Metsässä tai tunturissa sairastunut poro saattaa helposti kuolla kenenkään huomaamatta, kun sen sijaan kotipihan tarhassa ja halogeenivalon alla jo yksilön lievästi heikentynyt ruokahalukin voi olla eläimensä tuntevalle poromiehelle varoitusmerkki. Ainakin osa tarhauksen tartuntataudeista johtuu kuitenkin suuresta eläintiheydestä. Erityisesti vastustuskyvyltään heikentyneiden nälkiintyneiden porojen kerääminen tarhaan voi johtaa tautien nopeaan leviämiseen. Suurokkovirus (orf-virus, Palatsi y.m., 1993) ja tarttuvaa silmätulehdusta aiheuttava *Moraxella*-bakteeri (Oksanen y.m., 1996) leviävät suoraan eläimestä toiseen porojen tungeksiessa ruokintakaukalolla. *Toxoplasma gondii* -alkueläimen aiheuttama toksoplasmoosin suhteellinen yleisyys tarhaporoilla (lähestyen kotieläinmärehtijöiden, kuten lampaan, tartunnan yleisyyttä) selittyy sillä, että tartunta leviää kissan ulosteiden välityksellä, ja pihapiirissä ja rehuvarastoissa kissoja liikkuu.

Vaikka porot tarvitsevat ruokaa eläkseen, on lisäruokinnan järjestämisessä syytä huomioida myös tarttuvien tautien riski (Oksanen, 1998). Hajautettu lisäruokinta maastossa lienee tartuntatautien vastustuksen kannalta tarharuokintaa parempaa.

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Reindeer feeding and health

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Although some reindeer herders, for example Khanty people, feed their herds in order to tame the reindeer, the principal reason for winter feeding reindeer in the Nordic countries today is to sustain their health and productivity (Rehbinder & Nikander, 1999). Hinds in good body condition can give birth to healthy calves, and feed them. While the goal is mostly reached nowadays, it is unfortunately not seldom either that inappropriate feeding causes disease instead of promoting health.

One of the main problem causes is that easily digested fodder (e.g. grain, bread) too liberally administered very easily causes lactobacillar fermentation leading to ruminal acidosis and death very soon. This condition, although caused by overfeeding, very often comes as a total surprise to herders who perhaps recognise no change in feeding preceding the condition. This indicates that reindeer are very susceptible to ruminal acidosis.

When winter pastures are covered by ice, alarmed reindeer herders sometimes buy inferior surplus hay or ensilage from farmers. Even if the fodder would be appropriate to domestic ruminants, it is often too coarse and fibre rich for reindeer, being slowly digested, if at all. Coarse fodder can also cause damage to oral and other digestive tract mucosa. Moreover, fodder may even be spoiled by fungal and/or bacterial growth. Many of the different moulds produce various mycotoxins, which can cause different pathological changes and clinical symptoms, damaging e.g. mucosa, liver, kidneys, central nervous system or immune system. Some mycotoxins cause indigestion, others are carcinogenic, and some act as estrogen, causing persistent heat and abortions. It is not known how susceptible reindeer are to various mycotoxins, but it has been observed that reindeer attempt to avoid mouldy lichen pastures. Small concentrations of mycotoxins are perhaps ubiquitous and cannot be excluded totally, but any visible mould growth should cause the portion of fodder to be discarded.

Corral feeding almost inevitably leads to crowding, which makes contact between individual reindeer closer. Close contact between animals assists e.g. parapoxviruses to spread from the oral mucosa of one infected animal to another, either directly or via feeding trough (Tryland et al., 2001). *Moraxella* bacteria causing infectious keratoconjunctivitis spread when reindeer throng around the trough and eye contacts become very physical. Probably many other infectious agents spread similarly to these two mentioned.

Corral feeding domesticates, thus enabling micro- and macroparasites from domestic animals to infect reindeer. Increase in parasite transmission has been observed regarding the protozoan *Toxoplasma gondii*, which uses most, if not all, warm-blooded animal species as intermediate hosts, but only cats as definitive hosts. In the feline intestine, environment resistant oocysts are produced. In herding districts where feeding was rare, toxoplasmosis as measured by the presence of specific antibodies in slaughter reindeer serum also was rare, but in districts with widespread corral feeding *Toxoplasma* prevalence was higher, approaching (but not reaching) the prevalence measured e.g. in sheep (Oksanen et al., 1997).

As winter feeding of reindeer increases in the Nordic countries, health aspects, including the negative health consequences, deserve increasing attention.

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Smittsom munnskurv – en fôringsrelatert sjukdom hos rein

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I april måned 2000 ble det påvist smittsom munnskurv (engelsk: contagious ecthyma) forårsaket av parapoxvirus i en tamreinflokk i Nordland (Tryland et al., 2001a og b). Utbruddet fant sted hos dyr som hadde blitt fôret i innhegning fra desember måned. Sjukdomsutbruddet startet med at det ble observert ei voksen simle som stod og sturet i gjerdet og hadde problemer med å ta til seg næring. Dyrlege ble tilkalt, men simla var død da denne ankom. Simla ble obdusert ved Veterinærinstituttet Tromsø. Den veide 52 kg, var mager og dårlig muskelsatt. På over- og underleppa, på tannkjøttet til fortennene og bakover i ganen var det tett i tett med vorteaktige blomkållignende prosesser. Videre var det store sår med forråtnelse i tunga, og vond lukt fra munnhula. Noen dager seinere ble tilsvarende symptomer registrert på to drektige simler til, hvorav den ene døde og den andre ble avlivet i døende tilstand. Disse to dyrene ble obdusert på stedet og funnene tilsvarte i grove trekk funnene på den første simla. Samtlige dyr i flokken ble undersøkt og 30 dyr (20% av flokken) hadde klare symptomer på munnskurv. Disse ble skilt fra flokken og behandlet med antibiotika (Streptipenprokain® vet.; 1,3 ml/10 kg) mot bakterielle sekundærinfeksjoner. Til tross for behandlingen døde til sammen 7 dyr (4,7% av flokken). Resten kom seg og ble sluppet på fjellet i lag med de andre.

Parapoxvirus ble påvist fra skorpemateriale ved elektronmikroskopi. Ved hjelp av polymerase kjedereaksjon (PCR) og primerne PPP-1 og PPP-4 fra B2L-genet hos en virusstamme som gir munnskurv hos sau (Inoshima et al., 2000), ble det dannet oppformeringsprodukter av forventet størrelse (594 basepar), som også var i overensstemmelse med virusholdig materiale fra rein fra Finland (1992) og fra prøver fra ei geit fra Troms (1999), begge med munnskurv (positiv kontroller). Det er i dette tilfellet uvisst om viruset smittet fra sau til rein, eller om reinen har sin egen parapoxvirus-variant. På bakgrunn av utbruddet i Nordland og erfaringer fra Finland, der en har hatt munnskurv hos rein siden vinteren 1992-93 (Oksanen og Norberg, 1994), synes det klart at samling og hold av dyr i innhegning gjennom vinteren i fôringsøyemed disponerer for sjukdommen smittsom munnskurv. Smittepresset øker og dyrene smitter sannsynligvis hverandre via fôrtro og slikkesteiner. Videre vil virusholdige skorper falle av og bidra til at smitten opprettholdes i innhegningen. I og med at vinterfôring blir mer og mer vanlig, er dette en sjukdom vi kan komme til å se mer av i tida framover. Det bør derfor tas sikte på å avklare smitteforholdene, utbredelsen av viruset i ulike reinflokker og beiteområder, samt vurdere effekten av vaksinering av rein mot munnskurv.

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Contagious ecthyma – a disease related to feeding of reindeer

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In April 2000, the disease contagious ecthyma (Norwegian: smittsom munnskurv) caused by a parapoxvirus was diagnosed in a herd of semidomesticated reindeer in Nordland County, Norway (Tryland et al., 2001a and b). Approximately 150 animals had been coralled and fed since December. The first sign of the disease was the observation of an adult hind that gradually lost appetite, and had large chronic cauliflower-like papillomas on the lips and gums. The hind died and autopsy at the National Veterinary Institute Tromsø, revealed emaciation and acute fibrinous pleuropneumonia. The lips, rostral gums and the rostral part of the palate were covered with papillomas, and there were extensive necrosis of the tongue. Parapoxvirus papillomas and/or signs of secondary bacterial infections were observed in about 30 individuals (20% of the herd), some with only small and pink papular lesions, and some with chronic crust-covered papillomas. Animals with greenish mucopurulent saliva in the mouth caused by secondary bacterial infections were treated with antibiotics (Streptipenprocain® vet; 1.3 ml/10 kg). Altogether, 7 of the herd died (4.7 %) during the outbreak, and autopsies in the field revealed similar findings as described above. After treatment, the herd was let out of the fenced area to feed on mountain pasture.

Typical parapoxvirus particles were found in tissue samples from the papillomas by negative staining electron microscopy (2% phosphotungstic acid in dH_2O, pH 7.0). From tissue samples, 25 mg were mechanically homogenised and DNA was extracted. PCR primers (PPP-1 and PPP-4) of the B2L gene of orf-virus strain NZ2 (Inoshima et al., 2000) produced amplicons of the expected size (594 bp), and identical with samples from a reindeer from Finland (1992) and from a goat from Troms County (1999), both with contagious ecthyma (positive controls).

The source of the infection was unclear. One possibility is transmission from sheep. Contagious ecthyma is enzootic in sheep and goats in Norway. Reindeer and sheep may graze on the same mountain pastures, and parapoxvirus may remain viable for a long period in dry scabs under field conditions. Another possible explanation of the outbreak is the existence of subclinical parapoxvirus infections in reindeer. Based on the experience from this outbreak as well as from annual outbreaks in Finland since the winter 1992-93 (Oksanen et al., 1994), it seems clear that contagious ecthyma in reindeer is related to feeding. Keeping and handling herds in a fenced area for extended periods, combined with bad nutritional status and malnutrition, may be stress factors that trigger a clinical outbreak, and feeding from trough and the use of salt licks appear to be efficient means of transmitting the virus within a herd.

Feeding of reindeer seems to become more and more common, and we may experience more outbreaks in the future. The virus reservoir and the transmission and distribution of virus within and between herds should be characterized. Further, the effect of vaccination of reindeer against contagious ecthyma should be evaluated.

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Ruokinta ja poronlihan koostumus

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Porot teurastetaan Suomessa syksyllä ja alkutalvella, jolloin niiden kunto on parhaimmillaan. Kuohituista porohäristä saadaan lihaa 50-60, vaatimista 35-40 ja vasoistakin 20-25 kiloa. Teurasporoja ei yleensä ruokita. Talvinen porojen maastoruokinta on kuitenkin yleistä lähes kaikissa Suomen paliskunnissa. Tarharuokinta ja poronhoitoalueen ulkopuolella ympärivuotinenkin ruokinta lisääntyy. Ruokinnan vaikutuksia on syytä tutkin tarkemmin.

Poronhoitovuonna 1998-99 teurasmäärä Suomessa oli 96 260 poroa ja lihantuotto 2,2 milj. kiloa. Teurasporoista oli koko poronhoitoalueella vasoja keskimäärin 71, vaatimia 19 ja härkiä 7%. Erityisesti poronhoitoa varten tarkoitetulla alueella teuraista oli vasoja 67 ja vaatimia 21%, muulla alueella vastaavasti 74 ja 18%. Erityisellä poronhoitoalueella keskiteuraspaino oli 21,9, muulla alueella 24,7 kiloa. Ostoliikkeille myytyjen kaikkien porojen keskiteuraspaino oli 22,7, suoramyyntiin menneiden 24,4 ja omaan käyttöön otettujen korkein eli 25,2 kiloa. Lihantuotto/eloporo (elämään jätetyt vasat ja aikuiset porot) oli koko poronhoitoalueella keskimäärin 9,9, erityisellä poronhoitoalueella 7,6 ja muulla alueella 14,1 kiloa. Kolmena viimeisenä poronhoitovuonna lihantuotto/eloporo nousi yli 13 kilon erityisellä poronhoitoalueella vain Ivalon ja Pohjois-Sallan paliskunnissa. Kymmenen kilon tuotto ylittyi Kaldoaivin, Muddusjärven ja Muotkatunturin paliskunnissa. Luoteisella poronhoitoalueella lihantuotto/eloporo jäi jopa alle viiden kilon. Muulla alueella, jossa porojen lisäruokinta on talvella hyvin yleistä, eloporo tuotti lihaa keskimäärin 12,6 kiloa. Monin paikoin tuotto oli yli 16, jopa yli 18 kiloa/eloporo.

Aikaisemmissa tutkimuksissa joulukuussa vasojen teurasprosentti (teuraspainon osuus elopainosta) oli keskimäärin 46,2%. Kesäinen ja syksyinen ruokinta kaupallisella kesärehulla, jossa raakavalkuaista oli 20,7%, kohotti hieman vasojen elo- ja teuraspainoja. Rehuruokinta lisäsi myös eri sisäelinten ja ruhonosien painoa sekä luuttoman lihan määrää. Luonnonravinnolla olleiden vasojen lihaprosentti (luuttoman lihan osuus teuraspainosta) oli keskimäärin 71,8, vaadinten 70,1%. Rehuruokinnassa olleiden vasojen lihaprosentti oli korkeampi eli 74,6%.

Poronlihan valkuaispitoisuus on korkea, ja se sisältää runsaasti myös välttämättömiä aminohappoja. Erittäin runsaasti valkuaista on paisteissa ja takapotkassa. Syksyinen vasan liha sisältää valkuaista 2-3% enemmän kuin vaatimen liha. Rehuruokinta kesällä ja syksyllä ja myös ympärivuotinen rehuruokinta lisää poronlihan valkuaispitoisuutta. Sisäelimistä eniten valkuaista sisältävät maksa ja sydän ja kateenkorva.Poronlihan rasvapitoisuus on muihin hirvieläimiinkin verrattuna alhainen. Eniten rasvaa on porohärillä, talvella rehuruokinnassa keskimäärin 5,4 ja syksyllä luonnonravinnolla 12,2%. Kunnon huonontuessa rasvat häviävät ja liha muuttuu vetisemmäksi. Porohärkien lihan vesipitoisuus on keskimäärin 64, vasojen 71-75%. Erittäin vähän rasvaa porolla on kalvottomissa fileissä ja paisteissa, eniten kielessä, kalvollisessa ulkofileessä, satulassa ja rinnassa. Rehuruokinta kesällä ja syksyllä kohottaa hieman vasan lihan ja sisäelinten rasvapitoisuuksia. Useimmissa poron varastorasvoissa on eniten tyydyttymätöntä monoeeniä, öljyhappoa (18:1), seuraavaksi eniten tavallisia eläinrasvoja, tyydyttynyttä stearііni- (18:0) ja palmitiinihappoa (16:0). Myös vasan kateenkorvassa on runsaasti tyydyttymätöntä öljyhappoa. Poronjäkälissäkin on rasvahapoista eniten öljyhappoa. Syksyllä varsinkin luonnonravinnolla olleiden vasojen lihan monityydyttymättömien rasvahappojen eli polyeenien pitoisuudet ja myös P/S-arvot (monityydyttymättömät/tyydyttyneet rasvahapot) ovat korkeat ja korkeammat kuin esim. valkohäntäpeuralla ja hirvellä. Ympärivuotinen rehuruokinta lisää porolla rasvapitoisuuksia ja tavallisten eläinrasvojen, tyydyttyneiden rasvahappojen määrää. Rasvahappokoostumuksella on vaikutusta lihan laatuun ja makuun. Hienosyisen poronlihan energiasisältö on korkea. Poron rasvan energiasisältö on keskimäärin 34,5 MJ/kg. Vähärasvaisen vasanlihan energiapitoisuus on alhaisempi kuin aikuisten porojen.

Poronliha sisältää runsaasti eri vitamiineja, joista tärkeimpiä ovat monet B-ryhmän vitamiinit. Vasan lihan ja sisäelinten vitamiinipitoisuudet ovat yleensä korkeammat kuin vaadinten. Poronlihan ja sisäelinten riboflaviini- ja niasiinipitoisuudet ovat myös korkeammat kuin vastaavat naudan ja sian lihan pitoisuudet. Poronlihan ja varsinkin maksan A-vitamiinipitoisuudet ovat korkeat. Poronliha ja sisäelimet sisältävät runsaasti C-vitamiinia. Poronliha ja maksa sisältävät myös E-vitamiinia.

Poronlihan kivennäis- ja hivenainepitoisuudet ovat yleensä korkeat. Vasan lihan ja sisäelinten tuhkapitoisuudet ovat hieman korkeammat kuin vaadinten, ja usein korkeammat kuin hirven ja valkohäntäpeuran. Poronliha ja sisäelimet sisältävät runsaasti magnesiumia ja kaliumia. Vasoilla pitoisuudet ovat korkeammat kuin vaatimilla ja myös korkeammat kuin naudalla ja sialla. Pitkäaikainen ruokinta lisää poronlihan kivennäis- ja hivenainepitoisuuksia. Erittäin runsaasti poronlihassa ja sisäelimissä on rautaa. Vaatimella lihan rautapitoisuudet ovat hieman korkeammat mutta sisäelinten alhaisemmat kuin vasoilla. Rehuruokinta kesällä ja syksyllä kohottaa hieman vasan lihan, munuaisten ja kielen rautapitoisuuksia. Poronlihan seleenipitoisuudet ovat 5-10 kertaa korkeammat kuin naudanlihan pitoisuudet. Erittäin runsaasti seleeniä on poron maksassa. Poronlihan raskasmetalli (Cd, Pb) ja Cs- 137 -pitoisuudet ovat Suomessa alhaiset. Raskasmetallipitoisuudet ovat korkeammat poron maksassa ja munuaisissa. Ympärivuotinen ruokinta laskee suuresti jo alhaisia poronlihan Cs-137 –pitoisuuksia.

Feeding and chemical composition of reindeer meat

In Finland slaughtering period is antumn and early winter, when the condition of reindeer is the best. Castrated males can produce 50-60 kg, females 35-40 kg and calves 20-25 kg meat. Those reindeer to be slaughtered are not usually fed prior to slaughter, but winter feeding, however, on is common almost in all of reindeer herding districts in Finland. Feeding in the corrals and also feeding all year round is increasing outside reindeer herding area. It is of increasing importance to study the effects of feeding.

During the season 1998-99, the number of slaughtered reindeer was 96 260 and meat production 2.2 million. kg. 71 % of all slaughtered reindeer were calves, 19 % females and 7 % castrates. The mean carcass weight in designated reindeer husbandry area was 21.9 kg and in other area 24.7 kg. The mean weight of carcass which were sold for bulk buyers was 22.7 kg, for direct sale 24.4 kg and for own use 25.1 kg. The meat production/living reindeer in whole reindeer herding area was 9.9 kg, in designated area 7.6 kg and in other area 14.1 kg.

In our earlier studies carcass weight/live weight was 46.2 %. Feeding with concentrates (crude protein content 20.7 %) increased live, carcass and internal organ weights and also meat production of calves. Protein content and amount of essential amino acids in reindeer meat is high, and protein level is 2-3 % higher in calf than in adult female meat. Feeding during summer, autumn and also all year round with concentrates increased protein content in reindeer meat. Fat content of reindeer meat was low, and highest fat contents were measured for castrates fed with concentrates during winter (5.4 %) and kept on natural pastures during autumn (12.2 %). Feeding with concentrates during summer and autumn increased slightly fat content in calf meat. In most of the fat storages in reindeer we can find oleic (18:1), stearic (18:0) and palmitic fatty acids (16:0). Oleic acid content in *Cladonia*-lichen is also high. During autumn on natural pastures contents of polyunsaturated fatty acids and also ratio of polyunsaturated/saturated fatty acids in reindeer meat is high. Feeding all year round with concentrates increased fat content and amount of saturated fatty acids in reindeer meat. Energy content of reindeer meat is high, and the mean energy content of reindeer fat is 34.5 MJ/kg. Fatty acid composition has many effects to the quality and taste of meat.

Reindeer meat contains many vitamins, most important of them belonging to group of vitamin-B. The highest vitamin contents were measured from calf meat. Vitamin-A, -C and -E contents were high in reindeer meat and liver. Mineral and trace element contents were high in reindeer meat and internal organs. All year round feeding with concentrates increased mineral and trace element contents in reindeer meat. Iron content was very high in reindeer meat and internal organs. Feeding with concentrates during summer and autumn increased slightly iron content in calf meat and internal organs. Selenium content was 5-10 times higher in reindeer than in cow meat. Very high selenium contents were measured in reindeer liver. Heavy metal (Cd, Pb) and Cs-137 –contents were very low in reindeer. Higher heavy metal contents were measured from reindeer liver and kidneys. Feeding all year round with concentrates decreased significantly low Cs-137 -content in reindeer meat.

Effekter av utfodring på renköttets kvalitet

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Renskötsel i huvudsak baserad på utnyttjande av naturliga beten och renen tillgodoser då hela sitt näringsbehov från dessa beten. Trots det utfodras renar ibland under vintern för att förhindra att djuren utsätts för akut svält eller för att förbättra slaktkroppskvaliteten. I vissa områden används utfodring som en åtgärd att sänka innehållet av radioaktivt cesium i köttet (Åhman, 1999). Renarna utfodras antingen ute på sitt naturliga bete eller tas in i hagar och utfodras under en period på upp till 3 månader. Det är vanligt att använda kommersiellt renfoder vid denna typ av utfodring, eventuellt med ett tillskott av hö, ensilage eller lav. Senaste slaktsäsongen (1999/2000) slaktades 46 910 renar i Sverige (Statens Jordbruksverk, 2000). 18% av dessa (8347 renar) hade blivit utfodrade ca 2 månader innan slakt för att sänka innehållet av radioaktivt cesium i köttet (Åhman, 2000).
Att utfodra renar med kommersiellt renfoder (pellets) i 2 månader förbättrar djurens näringsmässiga status, ökar innehållet av glykogen i muskulaturen och minskar koncentrationen av särskilda blodmetaboliter som används som markörer för proteinnedbrytning av muskelvävnad eller stress (Wiklund *et al.*, 1996). Renar i god kondition har tillräckligt med glykogen i sina muskler för att garantera ett optimalt slut-pH-värde i köttet. Kött med ett högt slut-pH-värde (DFD-kött) är ett kvalitetsfel som avsevärt reducerar köttets hållbarhet, särskilt i vakuumförpackning. Dessutom påverkas köttets färg, textur och vattenhållande förmåga (Hood & Tarrant, 1981). Slaktkroppsegenskaper hos renar som utfodrats olika dieter har studerats och resultaten visade att djuren som utfodrats med pellets producerade slaktkroppar med högre släktutbyte och mer putsfett jämfört med de djur som utfodrats med en blandning av lav, sälglöv och blåbärsris (Wiklund *et al.*, 2000). En undersökning där konsumenter fick beskriva hur de uppfattade olika typer av renkött visade en mycket stor variation i vilket kött konsumenterna föredrog, oberoende av om de hade tidigare erfarenheter av renkött eller inte (Wiklund & Malmfors, 2000). En pilotstudie har också demonstrerat effekter av utfodring på renköttets fettsyrasamman-sättning (Wiklund *et al.*, 2001).

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Effects of feeding on the quality of reindeer meat

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Reindeer husbandry is generally based on the utilisation of native pastures and reindeer normally obtain all the nutrients they need from vegetation growing on these pastures. Nevertheless, reindeer are sometimes fed at times during the winter to prevent starvation or to improve body weight and condition. In some areas, feeding is used as a countermeasure to reduce radioactive caesium in the reindeer (Åhman, 1999). The animals are either fed in the field or brought into a corral and fed there for a period of up to 3 months. Commercial feed mixtures, specially prepared for reindeer, are commonly used in combination with hay, grass silage or lichens. Last slaughter season (1999/2000), 46 910 reindeer were slaughtered in Sweden (National Board of Agriculture, 2000). 18% of these (8347 animals) had been fed approximately 2 months prior to slaughter as a countermeasure to reduce radioactive caesium in the meat (Åhman, 2000).
The feeding of a commercial feed mixture (pellets) to reindeer for 2 months has been shown to improve the nutritional status, increase muscle glycogen stores and reduce the concentration of certain blood metabolites used as markers for protein catabolism or stress (Wiklund et al., 1996). In animals in good physical condition, the muscles contain enough glycogen to guarantee optimal ultimate pH values in the meat. Meat with high ultimate pH values (darkcutting or Dark, Firm, Dry) is a persistent quality defect that shortens shelf life, especially for vacuum-packed meat, and affects meat colour, texture and water-holding properties (Hood & Tarrant, 1981). Carcass characteristics of reindeer fed various diets were studied and it was concluded that animals fed pellets produced carcasses with higher dressing percentage and more trim fat compared with animals fed a mixed diet of lichens, bilberry brushwood and willow leaves (Wiklund et al., 2000). How the consumers appreciate different types of reindeer meat have also been studied, the results showed a broad variation in preference regardless if the consumer had earlier experience of reindeer meat or not (Wiklund & Malmfors, 2000). A pilot study have also demonstrated the effect of diet on fatty acid composition in reindeer meat (Wiklund et al., 2001).

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Fra overskudd til underskudd på vinterbeitekapasitet- Hvordan kan vi forklare utviklinga i Vest-Finnmark reinbeiteområde, Norge, 1960-2000?

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Den norsk-svenske reinbeitekommisjonen vurderte i 1967 Vest-Finnmark reindriftsområde til å ha klart overskudd på vinterbeitekapasitet. Fra midten av 1970-tallet til 1990 ble imidlertid reintallet fordoblet. Fra 1970-tallet til slutten av 1990-tallet er det registrert en omfattende reduksjon av stående lavbeitekapasitet. Mellom 1990 og 1999 er så reintallet redusert med en tredjedel, og tilleggsforing på vinterbeite forekommer langt oftere enn tidligere. Det ser ut til at det nå er vinterbeitekapasiteten som begrenser reintallet.
Hvordan kan vi forklare denne utviklinga? En sammenlikende studie med samisk reindrift i Trøndelagsområdene, som har opprettholdt en stabil og balansert beitetilpasning gjennom perioden, er gjennomført (Riseth, 2000). To ulike tilpasningsstrategier; *flokkøkning* og *produktivitetsøkning*, er registrert som typiske for henholdsvis Finnmark (her kalt Nord) og Trøndelag (her kalt Sør). Utgangspunktet for studien er at da ytre påvirkning (modernisering, markedstilknytning, teknisk endring, offentlig reindriftspolitikk) i store trekk er den samme, må vi søke forklaring i ulikheter mellom områdene. Både naturgeografiske og samfunnsmessige forklaringsfaktorer er undersøkt. Både beitebalanse og landskapskarakter er klart forskjellige i Nord og Sør. I Nord la kombinasjonen av åpent lende, beitebalanse og ny teknologi til rette for økende grad av sommerbeiting på høstbeitene, senere økende grad av høstbeiting på vinterbeitene. Samfunnsmessige faktorer var også klart ulike. I Sør opplevde bl.a. mange reineiere tida omkring 1970 som vanskelig og var på søk etter nye driftsmåter - de hadde også en lang tradisjon med organisasjonsarbeid og dialog med myndighetene. Reindriftspolitikken på 1980-tallet var også klart bedre tilpasset situasjonen i Sør enn i Nord.

Referanse

Riseth, J. Å. 2000. Sámi Reindeer Management Under Technological Change 1960-1990: Implications For Common-Pool Resource Use Under Various Natural And Institutional Conditions - A Comparative Analysis of Regional Development Paths in West Finnmark, North Trøndelag,and South Trøndelag/Hedmark, Norway. Dr. Scient. Theses 2000:1. Department of Economics and Social Sciences. Agricultural University of Norway. ISSN 0802-3222. ISBN 82-575-0411-4. Ås, Norway.

From excess to lack of winter pasture capacity- How can we explain the development of West Finnmark Reindeer Pasture Area, 1960-2000?

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In 1967 an expert commission assessed West Finnmark reindeer pasture area to have excess winter pastures. However, from the middle 1970's to 1990 total herd size was doubled. From the 1970s to the late 1990s a considerable reduction of standing lichen pasture biomass is registered. Further, between 1990 and 1999 herd size is reduced by one third, and supplementary winter feeding increased in abundance. Herd size now probably is limited by winter pasture capacity.
How can this be explained? A comparative study with Trøndelag areas, which has maintained a stable and balanced pasture adaptation in the period, is conducted (Riseth, 2000). Two different adaptation strategies; *herd expansion* and *productivity increase* are registered as typical for Finnmark (denoted North) and Trøndelag (denoted South) respectively. As external influence (modernization, market linking, technical change, public policy) is much the same, we should look for differences between the areas. Factors of nature geography and society are examined. Pasture balance and landscape character are distinctly different in North and South. I North the combination of an open landscape, pasture balance and new technology, promoted an increasing degree of grazing on lichen pastures out of season. Societal factors also differed clearly. In South many herders found the times around 1970 as difficult and were on search for new ways of herd management. South also had a long tradition of organization work and government dialogue. Public policy of the 1980s clearly was better adapted to the South than the North situation.

Reference

Riseth, J. Å. 2000. Sámi Reindeer Management Under Technological Change 1960-1990: Implications For Common-Pool Resource Use Under Various Natural And Institutional Conditions - A Comparative Analysis of Regional Development Paths in West Finnmark, North Trøndelag,and South Trøndelag/Hedmark, Norway. Dr. Scient. Theses 2000:1. Department of Economics and Social Sciences. Agricultural University of Norway. ISSN 0802-3222. ISBN 82-575-0411-4. Ås, Norway.

Poron loiset Fennoskandiassa – populaatiodynamiikka, torjuntakeinot ja niiden ympäristövaikutukset

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[4]Zoologisk Museum i Oslo, Norja.

Asiaan perehtyneiden keskuudessa on yleisesti tunnettua, että sekä sisäloiset (etenkin ruuansulatuskanavan ja keuhkon sukkulamadot) että ulkoloiset (kiiliäisten toukkamuodot) ovat Fennoskandian poroelinkeinolle erittäin merkityksellisiä. Asiaan perehtyneet tietävät lisäksi, että yksityiskohtainen kvantitatiivinen, epidemiologinen ja ekonominen tieto poron loisista puuttuu vielä.

Loisten merkityksen tunnustamista osoittaa, että 80% Suomen poroista lääkitään vuosittain loislääkkeillä. Lääkkeenä käytetään lähes yksinomaan ivermektiiniä. Tehokkuustutkimukset osoittavat tämän lääkkeen olevan erittäin tehokas poron merkityksellisimpiä sisä- ja ulkoloisia vastaan. Lääkitys aiheuttaa kuitenkin huolta arktisen herkän luonnon puolesta, koska ulosteissa erittyneen lääkkeen on osoitettu olevan myrkyllistä luonnon niveljalkaisille. Kaikki viittaa siihen, että talvella, kun lääkettä yleensä käytetään, lannansyöjähyönteiset eivät ole liikkeellä, eivätkä siksi joudu kärsimään. Lannan hajoitus ja ravinteiden kierrätys ovat kuitenkin tärkeitä tehtäviä läpi vuoden. Avainasemassa ovat vapaastielävät maasukkulamadot. Ivermektiinin vaikutuksesta näihin poronlannan hajoittajiin ei ole olemassa tutkimustietoa.

Poronhoidon kestävän kehityksen tiellä täytyy loisten merkitys tuotannolle ja kemiallisen loistorjunnan merkitys ympäristölle tutkia perusteellisesti. Tämän vuoksi on perustettu tutkimusryhmä, jossa on jäseniä Norjasta, Ruotsista ja Suomesta. Ryhmä on saanut rahoitusta ja on aloittamassa toimintaansa tänä vuonna (2001).

Macroparasites in Semi domesticated Reindeer of Fenno-scandia – Parasite Population Dynamics, Control Options, and Environmental Impact Implications

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It is widely recognised amongst those who are knowledgeable about the reindeer husbandry of Fennoscandia, that both internal parasites (gastro intestinal and pulmonary nematodes) and external parasites (larval stages of oestrid flies) are of major importance. However, it is also well known amongst these experts that detailed quantitative, epidemiological knowledge and economic significance of these parasites is seriously lacking. Most of the parasitological studies on reindeer have been restricted to the wild populations, which differ considerably from the management and environment under which the semi-domesticated reindeer of Fennoscandia are raised.
Recognition of the importance of parasites is illustrated by the fact that more than 80% of the semi-domesticated reindeer of Finland are treated every year with antiparasiticides. Similar statistics are likely to be the case for Norwegian and Swedish reindeer populations. Overwhelmingly the drug of choice is the macrocyclic lactone antparasitic, ivermectin. Efficacy studies indicate that this drug is highly effective against internal and external parasites of reindeer. However, there is concern about the impact that excreted drug has on the fragile northern environment This is because ivermectin residues excreted in the dung of treated animals has been shown to be toxic to a range of arthropods in the external environment. Some studies indicate that at the time that ivermectin is generally used in reindeer (early – mid winter), coprophagous insects are not active and thus not affected. However, dung breakdown and nutrient re-cycling is critical for dung deposited at any time of the year. For this to occur, beneficial, saprophytic soil nematodes are key organisms. No research has been conducted on the impact of ivermectin residues on nematode, or microbial, activity responsible for the breakdown of reindeer dung.
In the move towards achieving sustainability of semi-domesticated reindeer industry of Fennoscandia, the importance of parasites to their production and also the impact on the environment of chemical control methods, need to be comprehensively investigated. Towards this objective a research consortium has been developed between researchers in Finland, Norway and Sweden. This collaborative project has received funding and is scheduled to commence in 2001.

Tauluesitykset / Plakater / Posters – sessions

Fysiologia / Fysiologi / Physiology

Gjøstein, H, Ø. Holand, K. Hove & T. Bolstad.
Melkenedgivningsrefleksen hos reinsdyr / The milk let down mechanism in reindeer.
Koho, N. M., V. Maijala, M. Nieminen & A. R. Pösö.
Haihtuvien rasvahappojen kuljetus solumwmbraanien läpi / Volatile fatty acid transport across cell membranes.
Lefrère, S. C., M. Nieminen, T. Mossing & J. Goldberg.
Poron vasan (*Rangifer tarandus tarandus* L.) erottamisen vaikutus imentään, maidontuottoon ja sydämen sykkeeseen koeoloissa / The effect of separation of reindeer calf (*Rangifer tarandus tarandus* L.) on suckling events, milk yield and heart rate under experimental conditions.
Nilsson, A., M. Murphy & B. Åhman.
Effekt av foderstat på vommikroorganismer i renar / Dietary effects on rumen microbes in reindeer.
Olsen, M. A, T. A. Utsi, R. Rødven & S. D. Mathiesen.
Ernæringsmessige effekter av fôring på blodparametre i rein / Nutritional effects of articicial feeding. on serum biochemistry in reindeer
Pösö, A. R., U. Heiskari, M. Lindström, M. Nieminen & T. Soveri.
Lihasten valkuaisaineaineenvaihdunta kaupallisella rehulla ruokituissa ja rajoitetulla jäkäläruokinnalla olleissa poronvasoissa talvella / Muscle protein metabolism in fed and undernourished reindeer calves during winter.
RKTL. Finlands renforskning / Reindeer research in Finland.
Ryeng, K. A., S. Larsen, B. Ranheim, G. Albertsen & J. M. Arnemo.
Klinisk evaluering av nyetablerte optimale immobiliseringsdoser av medetomidin-ketamin hos oppstallet rein (*Rangifer tarandus tarandus*) / Clinlcal evaluation of established optimal immobilizing doses of medetomidine-ketamine in captive, semi-domesticated reindeer (*Rangifer t. tarandus*).
Soppela, P.
Poron kunto ja eri kudosrasvojen rasvahappokoostumus / The fatty acid composition of different tissue fats in reindeer as related to nutritional condition.
Åhman, B., J. Wallsten, Ö. Danell & P. Udén.
Smältbarhet av lav och ensilage i vomvätska från ren / Digestibility of lichens and silage in reindeer rumen fluid.

Laidun ja ruokinta / Beite og fôring / Pasture and feeding

Heiskari, U., M. Nieminen & L. Syrjälä-Qvist.
Wilted and unwilted grass silage in reindeer winter feeding.
Josefsen, T. D., K. K. Sørensen, T. Mørk, S. D. Mathiesen & K. A. Ryeng.
Sultedød på tross av fôring – et tilbakevendende problem i praktisk reindrift / Starvation death despite feeding – a recurring problem in reindeer husbandry.
Norberg, H., V. Maijala & M. Nieminen.
Poron ravintokasvien, -sienien ja -jäkälien maittavuus ja ravintosisältö / Palatability and nutrient composition of plants, fungi and lichens foraged by reindeer.
Pentha, S. M., N. Tyler & P. Wookey.
Eksperimentell oppvarming av beiteplanter for rein *in situ* øker produksjonen av planter / Experimental warming of reindeer forage plants *in situ* increases their growth.
Skarin, A., Ö. Danell, R. Bergström & J. Moen.
Interaktioner mellan ren, människa och topografi / Interactions between reindeer, humans and topography.
Säkkinen, H., E. Eloranta, S. Vahtiala, M. Puukka, J. Timisjärvi, S. Saarela & E. Ropstad.
Magnesiumia sisältävät pötsibolukset poron Mg-lisänä / Magnesium alloy rumen boluses as Mg–supplement for reindeer.
Uhlig, C. & T. Sveistrup.
Innvirkning av reinsdyrbeiting på jordegenskaper på Finnmarksvidda / Impacts of reindeer grazing on soil properties.
Weydahl, H. T.
Fôring av avmagrede og underernærte reinsdyrkalver – fordypningsoppgave ved Norges veterinærhøgskole / Feeding of emaciated and undernourished reindeer calves – a degree project at the Norwegian School of Veterinary Science.

Tuotanto / Produksjon / Production

Bergkvist, L.
Resurs- och företagsekonomisk analys av renskötselföretag / Resource and Business Economic Analysis of Reindeer Husbandry Firms
Breie, H., Ø. Holand & R. B. Weladji.
Effekt av globalt klima på høstvekter hos reinsdyrkalv (*Rangifer tarandus*) / Effect on global climate on autumn calf weight in reindeer (*Rangifer tarandus*).
Henaug, C., T. Tveraa, P. Fauchald & N. G. Yoccoz.
Naturlig produksjon og høsting i reindriftsnæringen / Production and harvesting in the reindeer husbandry industry.
Holand, Ø, P. Aikio, H. Gjøstein, M. Nieminen, K. Hove & R. G. White.
Modern reindeer dairy farming – the influence of machine milking on udder health, milk yield and composition.
Karlsson, A-M.
Beslutsfattande inom rennäringen / Decision making in reindeer herding.
Kumpula, T., A. Manderscheid & A. Colpaert.
Luonnonlaitumet ja paimentolaistalous: esimerkkinä tiibetin ylänkö / Natural pastures and mobile animal husbandry management: A case study on the Tibetan plateau.
Norberg, H., V. Maijala, M. Nieminen & J. Kumpula.
Vasatuoton ja – kuolleisuuden arvioinnissa käytetyt menetelmät / Methods in assessing reindeer calf production and mortality.
Reindriftsforvaltningen i Norge.
Norwegian Reindeer Husbandry: administration and management.
Ropstad, E., S. D. Albon, O. Johansen, R. Pedersen, E. Dahl & N. J. C.Tyler.
Reproduksjonssuksess hos rein relatert til variasjon i klimafaktorer / Reproductive success of reindeer associated with climate variability.
Rødven, R. & N. J. C. Tyler.
Korttids tap i kroppsmasse hos rein / Short-term loss in body mass in reindeer.
Tyler, N. J. C. & R. Rødven.
Livstidsreproduksjonssuksess er ikke en funksjon av gjennomsnittlig levendevekt hos voksne rein / Fertility is not a function of mean live body mass in adult female reindeer.
Wiklund, E. & I. Hansson.
Slaktkroppssammansättning i relation till vikt och kondition hos renkalvar / Carcass composition of reindeer calves in various physical condition.
Ågren, E.
Orsaker till perinatal dödlighet hos renkalvar i hägn / Causes of perinatal mortality in reindeer calves.

Sairaudet ja terveys / Sykdom og helse / Health issues

Aschfalk, A., & N. Denzin.
Serumprevalensen for *Salmonella* spp i tamrein i Finland og Norge / Seroprevalence to *Salmonella* spp in semi-domesticated reindeer in Finland and Norway.

Aschfalk, A., K. A. Ryeng & C. Höller.
Forekomst av *Campylobacter* spp, *Clostridium perfringens, Salmonella* spp, *Yersinia* spp og shigatoxin-1,2-produserende bakterier hos kadaver av tamrein i Nord-Norge / Occurrence of *Campylobacter* spp, *Clostridium perfringens, Salmonella* spp, *Yersinia* spp and shigatoxin-1,2-producing bacteria in semi-domesticated reindeer cadavers in northern Norway.

Johnsen, Ø. & S. D. Mathiesen.
Nye muligheter for bruk av telemedisinske løsninger i reindriften / Future perspectives in use of telemedicine in reindeer husbandry.

Josefsen, T. D., Mørk, T., Sørensen, K. K. & Ryeng, K. A.
Lungemarkinfeksjon hos rein / Lungworm infeetion in reindeer.

Nergård, E. R.
Slakteforskrifter for reinsdyr og oppdrettsvilt kontra viltkjøtt forskrifter / The slaughterhouse law of reindeer and breeded game, compared to the law of game meat.

Rissanen, K., J. Ylipieti & Y. Norokorpi.
Tidmässiga trender för ^{137}Cs halter i skogssvampar - inverkan på renar efter en kärnkraftverksolycka / Time trends of Cs-137 in wild mushrooms-influence on reindeer after a nuclear accident.

Ryeng, K. A., T. D. Josefsen, K. K. Sørensen, T. Mørk, M. Tryland, A. Aschfalk, S. D. Mathiesen, I. Schjelderup, H. G. Åmot & R. G. Sarre.
Tap og dødelighet hos rein i Finnmark - et forprosjekt / Loss and mortality in reindeer in Finnmark County, Norway – a preliminary project.

Sørensen, K. K., T. Mørk, T. D. Josefsen & K. A. Ryeng.
Patologiske funn hos rein som har dødd av underernæring / Pathological findings in reindeer succumbed to starvation.

Tikkanen, M., V. Hirvelä-Koski, M. Nylund, E. Neuvonen, L. Sihvonen & A. Huovilainen.
Parapoxvirus porojen suutaudin aiheuttajana 1999-2000 / Parapoxvirus infection in Finnish reindeer 1999-2000.

Tryland, M., T. D. Josefsen & A. Oksanen.
Smittsom munnskurv – en fôringsrelatert sjukdom hos rein.

Weladji, R. B.
Estimering av effekt av insektplage, modellert ved hjelp av klimadata, på vekts hos reinsdyr om sommeren / Use of climatic data to estimate the effect of insect harassment on summer weight gain in reindeer *(Rangifer tarandus)* calves.

Ågren, E.
Missbildningar hos renkalvar / Malformations in reindeer calves.

Åsbakk, K., R. E. Haugerud, M. Nieminen, A. C. Nilssen & A. Oksanen.
Reinens hudbrems - *Hypoderma tarandi* - om egenskaper ved førstestadiums-larven / Reindeer warble fly - *Hypoderma tarandi* - histological and immuno-histological properties of the 1st instar larvae.

Tauluesitykset / Plakater / Posters

(aakkosjärjestyksessä / i alfabetisk rekkefølge / in alphabetical order)

Serumprevalensen for *Salmonella* spp i tamrein i Finland og Norge

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Målet med prosjektet er å evaluere betydningen av salmonellainfeksjon hos tamrein i Finland og Norge. Totalt 3032 serumprøver ble undersøkt for forekomst av antistoffer mot *Salmonella* spp i en indirekte LPS-mix-ELISA. Prøvene fra Norge (antall 2000) og flertallet av prøvene fra Finland (antall 802) kom fra klinisk friske slaktedyr, resten av de finske prøvene (antall 230) kom fra en flokk som var permanent inngjerda. Tilfeller av tarmforstyrrelser ble rapportert i denne flokken. I 21 serumprøver fra Finland og 12 fra Norge ble det påvist en høyere verdi enn grenseverdien. Den totale prevalensen hos rein i Finland var 2.8% og i Norge 0.6%. Serumprevalensen hos friske finske slakterein var 0.9% og hos permanent inngjerda rein varierte den mellom år fra 4.3% til 12.9%. Den relativt lave serumprevalensen for *Salmonella* spp som ble funnet i Norge kan sammenliknes med den som ble funnet hos friske slaktedyr i Finland. Samling av dyr kan ha betydning for økning av infeksjoner.

Seroprevalence to *Salmonella* spp in semi-domesticated reindeer in Finland and Norway

Aim of this project is to evaluate the importance of salmonellosis in semi-domesticated reindeer in Finland and Norway. A total of 3032 serum samples from reindeer were examined on the presence of antibodies for *Salmonella* spp in an indirect LPS-mix-ELISA. The Norwegian samples (n=2000) and most of the Finnish reindeer samples (n=802) were obtained from clinically healthy slaughter animals, the remaining Finnish samples (n=230) from a permanently corralled herd, where cases of diarrhoea were reported. Twenty-nine serum samples from Finland and 12 from Norway had a higher optical density value for *Salmonella* spp than the determined *Cut-off*. The overall prevalence in reindeer in Finland was 2.8% and in Norway 0.6%. The determined seroprevalence of the clinically healthy slaughter animals in Finland was 0.9%, the one found in reindeer from the permanently corralled herd varied between 4.3% and 12.9% (determined in 3 consecutive years). The rather low seroprevalence for *Salmonella* spp found in Norway is similar to the one found in clinically healthy slaughter animals in Finland. Corralling may eventually increase infections among reindeer.

Forekomst av *Campylobacter* spp, *Clostridium perfringens*, *Salmonella* spp, *Yersinia* spp og shigatoxin-1,2-produserende bakterier hos kadaver av tamrein i Nord-Norge

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Det finnes lite informasjon om bakterier som har potensial til å forårsake tap og dødelighet hos, tamrein (*Rangifer tarandus tarandus*) på beite. Bakterier som f. eks. *Campylobacter* spp, *Clostridium perfringens*, *Salmonella* spp og *Yersinia* spp, er blant de viktigste agens som forårsaker tarmsykdommer hos domestiserte drøvtyggere. Derfor kan en betydning av disse bakteriene i reindriften i Norge, ikke utelukkes, selv om *C. perfringens* hittil åpenbart er den eneste av disse bakteriene som er rapportert å forårsake dødelighet hos rein i Norge. I tillegg kan det muligens også forekomme tarmbakterier hos rein som er av betydning for helse hos mennesker, som shigatoksin-1,2-produserende bakterier (f.eks. EHEC). I dette delprosjektet ble avføringsprøver fra 35 rein, voksne og kalver, som døde vinteren 2000 i Finnmark, undersøkt for forekomst av *Campylobacter* spp, *C. perfringens*, *Salmonella* spp, og *Yersinia* spp. I tillegg ble 31 av disse prøvene undersøkt for tilstedeværelse av shigatoksin-1,2-produserende bakterier, siden rein muligens kan fungere som et reservoar for disse bakteriene. *C. perfringens* ble isolert i 20 (57.1%) av prøvene og genet som koder for shigatoksin-1 ble påvist i en av prøvene (3.2%). *Campylobacter* spp, *Salmonella* spp, *Yersinia* spp og shigatoksin-2-produserende bakterier ble ikke påvist. Shigatoksin-1-produserende bakterier ble hermed påvist for første gang hos rein. Det finnes få rapporter om sykdommer hos drøvtyggere forårsaket av shigatoksin-produserende bakterier, men de er av stor betydning ved å forårsake alvorlige sykdommer hos mennesker. *C. perfringens* er tidligere isolert fra reinsdyr, og er kjent for å ha potensial til å forårsake dødelighet hos reinsdyr, men bare i samvirkning med andre faktorer. I dette prosjekt var det ikke mulig å finne noen assosiasjon mellom tilstedeværelse av *C. perfringens* og shigatoksin-1-produserende bakterier og dødelighet hos reinsdyr. Undersøkelsen ble gjennomført som del av det RFR-finanserte forprosjektet "Tap og dødelighet hos rein i Finnmark".

Occurrence of *Campylobacter* spp, *Clostridium perfringens*, *Salmonella* spp, *Yersinia* spp and shigatoxin-1,2-producing bacteria in semi-domesticated reindeer cadavers in Northern Norway

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There is little information on bacteria that have the potential to cause diseases and mortality in free-ranging, semi-domesticated reindeer (*Rangifer tarandus tarandus*). Bacteria, such as *Campylobacter* spp, *Clostridium perfringens*, *Salmonella* spp, and *Yersinia* spp are among the most important agents in causing enteric diseases, as known from domestic ruminants, and thus, a certain importance of these bacteria in reindeer husbandry in Norway may not be excluded, as well, even though *C. perfringens* obviously was the only one of these bacteria reported to cause mortality in reindeer in Norway, so far. In addition, enteric pathogens with a major interest on human health, such as shigatoxin-1,2-producing bacteria (e.g. EHEC), may also occur in reindeer. In this project, faeces samples from 35 reindeer, adults and calves, that died in winter 2000 in Finnmark county, were examined for the occurrence of *Campylobacter* spp, *C. perfringens*, *Salmonella* spp, and *Yersinia* spp. In addition, 31 of these samples were examined for the occurrence of shigatoxin-1,2-producing bacteria, as reindeer may be a potential reservoir of these pathogens. *C. perfringens* was isolated in 20 (57.1%) of the faeces samples and the gene encoding for shigatoxin-1 was detected in one of the samples (3.2%). *Campylobacter* spp, *Salmonella* spp, *Yersinia* spp and shigatoxin-2-producing bacteria were not found. Shigatoxin-1-producing bacteria were isolated for the first time from reindeer. Even though there are few reports on diseases caused by shigatoxin-producing bacteria in ruminants, they are of extreme importance in causing severe diseases in humans. *C. perfringens* was isolated from reindeer before and is known to have the potential to cause mortality in reindeer, but only, if other factors coincide. In this study, an evidence on the association of the occurrence of *C. perfringens* and shigatoxin-1-producing bacteria and the mortality in reindeer, however, could not be provided. This examination was performed as part of the preliminary project "Loss and Mortality of Reindeer in Finnmark County", financed by the Reindeer Husbandry Research Fund.

Resurs- och företagsekonomisk analys av renskötselföretag

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Syftet med detta projekt är att skapa planeringsinstrument för renskötselföretag samt använda dessa instrument för analyser av renskötselföretag och samebyar. Projektet baseras på material från intervjuer, enkäter samt befintliga data om rennäringen . Det finns viktiga skillnader mellan andra typer av företag och renskötselföretag som baseras på den nära kopplingen till samisk kultur samt att renägaren inte äger den mark där produktionen sker. För att ekonomiska planeringsinstrument ska kunna användas i renskötselföretaget behöver en modell utvecklas som tar hänsyn till dessa skillnader. Ett renskötselföretag producerar inte bara renkött utan är också den primära bäraren av samisk kultur. Idag är den viktigaste informationskällan när beslut ska fattas, oftast äldre släktingar eller kolleger. Det finns idag ett gap mellan tillgänglig information och det som efterfrågas för att bättre kunna planera företaget. En nödvändig förändring av renskötselföretagen mot ökad lönsamhet innebär förmodligen att företagen måste satsa mer på kompletterande näringar. Med tanke på ovanstående är det extra viktigt att bredda utbudet av lämpliga binäringar och att presentera det mervärde som dessa binäringar kan ge renskötselföretaget. Det är inte bra att arbeta under den press som många renskötselföretagare känner idag om man som företagare vill utveckla sitt företag. Allteftersom kunskapen om renskötselföretagen ökar kommer förmodligen eventuella konflikter mellan olika markanvändare och andra intressenter att kunna minskas. Projektet har hittills genererat följande resultat vilka också kommer att presenteras i postern:

- bidragskalkyler (operativa ekonomiska planeringsinstrument)
- en modell för hur strategisk planering kan ske i ett renskötselföretag
- exempel på lämpliga binäringar för renskötselföretag.

Resource and Business Economic Analysis of Reindeer Husbandry Firms

The aim of this project is to develop planning tools for reindeer husbandry firms and to use these instruments for analyses of reindeer husbandry firms and herding communities. The project is based on interviews, inquiries and current data from the reindeer industry. There are important differences between other kinds of firms and reindeer husbandry firms. These differences are based on the close connection to Sami culture and the fact that the manager does not own the land that is used for reindeer herding. For the efficient use of economic planning tools, a model needs to be developed where these aspects are recognized. The reindeer husbandry firm does not only produce reindeer meat but is also the primary carrier of Sami culture. Today the most important source of information when decisions are made, comes from older relatives or colleagues. The implication of this is that there is a gap between available and wanted information in current reindeer husbandry firms when decisions are made. A necessary change towards an increased profitability does most probably mean more investments on supplementary enterprises. Considering the above, it is essential to broaden the supply of suitable supplementary enterprises and to present the added value of those supplementary enterprises to the reindeer husbandry firms. It is not good to work under the pressure that most reindeer husbandry managers feel today, if you at the same time want to develop your firm. When knowledge about reindeer husbandry firms increases, possible conflicts between different land-users and other stake-holders decreases. This project have so far generated the following results, which also will be presented in a poster:

- Enterprise budgets (operative economic planning tools)
- A model for how strategic planning could be conducted in reindeer husbandry firms
- Examples of suitable supplementary enterprises for reindeer husbandry firms.

Effekt av globalt klima på høstvekter hos reinsdyrkalv (*Rangifer tarandus*)

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I det senere har det blitt påvist at globale klimaregimer kan påvirke flere livshistoriske og økologiske sider hos store herbivorer. Ved å bruke " North Atlantic Oscillation" (NAO) indeks gjennom vinteren, har vi estimert effekten av global klimatisk variasjon på slaktevekter av reinsdyrkalv i tre populasjoner i Midt-Norge fra 1992 til 2000. I alle tre populasjonene varierte høstvektene mellom år og kjønn signifikant. Videre hadde NAO indeksen signifikant positiv effekt på høstvektene, men effekten varierte mellom populasjonene. Modellen forklarte omtrent 30% av årlig variasjon i høstvektene. Resultatene tyder på at høy NAO indikerer gunstige betingelser for reinsdyr i Midt-Norge. Dette studiet støtter hypotesen om at variasjoner i det globale klima kan påvirke populasjonsdynamikken hos store planteetere.

Effect of global climate on autumn calf weight in reindeer (*Rangifer tarandus*)

It has recently been shown that global climatic regime has the potential to influence several aspects of life history and ecology of terrestrial large mammalian herbivores. Using the North Atlantic Oscillation (NAO) index during winter, we estimate the effect of global climatic variability on carcass weights of reindeer calves in three mid-Norwegian populations from 1992 to 2000. In all three populations, autumn body weight varied significantly with both year and sex. Furthermore, the NAO index had a significant positive effect on autumn body weight, but the effect varied between populations. The model explained about 30% of the inter-annual variation in autumn body weight. Our results suggest that a high NAO index indicates favourable winter conditions for reindeer in Mid-Norway. This study supports the hypothesis that global climatic variability may affect large herbivores' population dynamics.

Melkenedgivningsrefleksen hos reinsdyr

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I et kommersielt driftsopplegg med melking av reinsdyr er nedgivning av melk hos simlene essensielt. Effekten ulike stimuleringsmetoder hadde på nedgivninga og dermed melkeytelsen ble undersøkt. Vi benyttet to ulike behandlinger der kalven ble brukt for å stimulere simlene til nedgivning. I det ene forsøket lot vi simlene ha syns-, lyd- og luktkontakt med kalven under melkingen og i det andre ble simlene diet av kalven i ca 2 sekunder før simlene ble melket . I begge behandlingene ble juret vasket med en varm klut og alle spenene håndmelket før påsett av melkeorgan.
Gjennomsnittlig melkeytelse ble testet i en generell lineær modell (GLM) der vi tok inn individuell variasjon og periode for og teste effekten av syns-, lyd- og luktkontakt med kalven under melkingen. Modellen var signifikant (r^2=0.93, F_{15}=9.4, P<0.005), men bare effekten av individuell variasjon bidro til modellen (F_7=11.8, P<0.005).
En generell lineær modell (GLM) som innbefattet individuell variasjon og periode ble også benyttet for og teste effekten av kort diing på andelen residualmelk i forhold til total melkeytelse. Modellen var signifikant (r^2=0.99, F_7=9.4, P<0.05). Behandlingen med diing bidro sterkt til modellen (F_1=293.8, P<0.005).
Vi konkluderer med at syns-, lyd- og luktkontakt med kalven under melkingen ikke har noen innvirkning på melkenedgivninga. Kort diing av kalv utløser nedgivningsrefleksen og gjør det mulig og tømme juret fullstendig med maskinmelking.

The milk let down mechanism in reindeer

In a commercial reindeer dairy farming the milk let down mechanism and hence yield is essential. We tested the effect of two different treatments where calf was applied to stimulate the milk let down of the doe. In experiment 1 the doe had olfactory,- audio- and visual contact with the calf during milking and experiment 2 the calf was allowed suckle the doe for 2 seconds followed by machine milking. In both experiments the udder was massaged with a warm cloth and the nipples was handmilked for a short time before machine milking.
A general linear model (GLM), taking into account individual variation and sampling period was established, in order to test the effect of olfactory,- audio- and visual contact during milking session on let down i.e. on average milk yield. The model was highly significant (r^2=0.93, F_{15}=9.4, P<0.005). However, only individual animal variation contributed significantly to the model (F_7= 11.8, P<0.005). A general linear model, taking into account individual variation and sampling period, was also established in order to test the effect of short suckling on the proportion of residual milk in relation to total yield. The model was significant (r^2=0.99, F_7=9.4, P<0.05). Suckling was the major contributor to this model (F_1=293.8, P<0.005).
We conclude that olfactory -, audio - and visual contact with the calf during the milking session did not affect the let down mechanism. Short suckling by calf induced the let down and enabled a complete emptying of the udder by machine milking.

Wilted and unwilted grass silage in reindeer winter feeding

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Grass silage is commonly used in winter feeding of reindeer, especially in the southern parts of reindeer herding area in Finland. In recent years the round baled grass silage has become more common also in the northern reindeer herding districts. Silage is usually given in addition to other feeds, for instance hay, cereals or concentrates. The high water content of grass silage (75-80%) causes problems of freezing during cold winter. The water content of silage can be decreased with wilting of the grass before ensiling. Silage has not been recommended as a sole feed to reindeer in long-time feeding, while the use of silage in shorter feeding periods has been successful. Wilted and unwilted grass silage as a sole feed or with added concentrate feed was studied in long-term winter feeding trials in two-year experiment with adult female reindeer.

Two groups of adult female reindeer (n=8) were in *ad libitum* feeding from January until the beginning of April during two winters. One group in each year was fed with precision-chopped, wilted grass silage and the other with unwilted, flail-harvested grass silage. All silage was early harvested from mixed grasses (timothy, meadow-grass, *Poa* spp.), preservative (mainly formic acid) was added at the chopping stage and silage was preserved in bunker silos. The quality of all silage was good, no fermentation differences were observed between different silage types. The dry matter content varied from 19% (unwilted, second winter) to 41% (wilted, first winter) in different silage types. During the second year the reindeer were fed with the concentrate feed in addition to silage (875 g/animal/day). The control groups grazed on winter pastures. Daily feed intake as mean of eight reindeer and weekly body weights (the control groups monthly) were recorded and the chemical composition of blood serum was determined once a month.

The daily dry matter intake varied between 0.5-2.0 kg/reindeer, which is about 10-21.5 g DM/kg live weight and the intake of wilted silage was slightly higher than the intake of unwilted silage in the beginning of the experiment during the first winter. The addition of concentrates decreased the dry matter intake of silage on average by 5%. There were no significant differences in the total dry matter intake of any experimental group. No digestive problems were determined and the animal health was stable during the experiments. The feeding groups increased their body weights and the control animals lost slightly body weight during the experiments. There were no significant differences neither in the body weights, nor in the blood serum values of the experimental groups.

Both wilted and unwilted grass silage was found to be palatable feed for adult reindeer. The dry matter intake of silage determined in this study was at the same level or slightly higher than in previous experiments. The added high quality concentrate feed decreased the intake of silage. The results indicate that wilted and unwilted grass silage can be solely fed to adult reindeer during winter in *ad libitum* basis and with special care of silage quality. Because of the high percentage of silage residues in *ad libitum* feeding, silage is recommended as main part of diet with added concentrates etc. or as a supplement to winter pasture in the practical winter feeding of reindeer.

Naturlig produksjon og høsting i reindriftsnæringen

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Reindriften i Finnmark har i de senere år vært preget av svært lav produksjon, og spesielt har tapene rett etter kalving vært store. Det har vært argumentert for at denne utviklingen skyldes økt rovdyrtetthet, ugunstige miljøforhold og høye reintall. Dette studiet har til hensikt og skaffe til veie estimater over omfanget av rovdyrdrepte kalver, hvilke rovdyr som forårsaker tapene, og hvordan tapene er relatert til kondisjonen til simlene.
Simlene i studiet kalvet på et inngjerdet område og ble fóret under kalvingsperioden. Kalvene ble så påmontert dødsvarsel sendere og fulgt i ca. én måned etter slipp fra kalvingsgjerdet. Resultatene viste en nøye sammenheng mellom simlenes vekt og deres evne til å bære frem kalven. Simlene skilte seg hovedsakelig i tre vekt grupper. Gruppen med de letteste simler aborterte kalven, de noe tyngre simlene mistet kalven rett etter fødselen og de tyngste simlene forlot kalvingsgjerdet med kalv. Den siste gruppen hadde også de tyngste kalvene. Rundt 22% kalver gikk tapt, hovedsakelig til fredet rovvilt, den første måneden etter at simle og kalv ble sluppet på frie beiter. Disse simlene var da også betydelig lettere enn simler som fortsatt gikk med kalv da studieperioden var over.

Production and harvesting in the reindeer husbandry industry

The reindeer husbandry industry in Finnmark County, Norway, has in the last decade struggled with low production. In particular, the losses right after the calving period has been high. It has been argued that this development is due to factors like increased predator populations, unfavourable environmental conditions and high numbers of animals. This study was designed to gather estimates of the extent of calves killed by predators, which predator causes the losses, and how the losses are related to the body weight of the females. All females in this study were kept in a calving fence and fed throughout the parturition period. The calves were marked with mortality collars and daily search for dead calves was carried out for one month after they were let out of the fence.
The results show a close relationship between female body weight and their ability to produce live offspring. The females separated mainly in three different weight groups. Females with the lowest weight experienced miscarriage, while the group of "heavier" females lost their calves few hours after birth and the heaviest group left the fence with their offspring. The latter group tended to have heavier calves. The first month after the females and their calves were let out of the fence, about 22% of the calves were lost to legally protected predators. This group of females was however the females with the lowest weight compared to those females which still had their calves at foot by the end of the study period.

Modern reindeer dairy farming – the influence of machine milking on udder health, milk yield and composition

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Our main objectives were: 1) to test if the reindeer mammary gland (udder) could tolerate regular long-term machine milking, 2) to record milk yield of reindeer exposed to regular long-term machine milking and 3) to document changes in milk composition through a 3 month experimental period (July, August and September 1999). Adult female reindeer were allotted to four groups of four. Treatments were: Group 1, weekly milking with calves at foot (control); Group 2, 2 milkings/d, no calves at foot; Group 3, as for group2 with a pre-milking oxytocin injection (i.m. 10 IE); Group 4, as for Group 1 with 6 h separation of calf and cow before milking. Vacuum pressure was set to 25 kPa, pulse rate to 100 pulses/min with a suckling: massage ratio of 60:40. Somatic Cell Count, a measure of udder health, stabilized below 150.000 per ml in all groups and no morphological changes in teat characteristics were observed, indicating that udder health was not affected by long-term regular machine milking. Average milk yield for Group 1 was 50 g, whereas a yield of 380 g/d was achieved for Group 3 (no nursing and injected with oxytocin). Milk yield of Group 3 was 4 fold higher than Group 2 (90 g/d), which was milked twice daily but had no nursing and no injections of oxytocin. Separation of calves for 6h before daily milking (Group 4) yielded 35g/d. Based on the effectiveness of oxytocin, we conclude that milk letdown mechanisms are critical for effective emptying of the udder. A treatment reversal trial was conducted for a week late in the experimental period: For Group 3 mean daily milk yield when injected with saline although lower than the yield with oxytocin was greater than Group 2 which showed a 10-20% increase due to oxytocin; the 6h mean milk yield of Group 4 when injected with oxytocin, was 6 fold higher (215 v 35 g). We conclude that; a) oxytocin is effective in all treatments, b) oxytocin condition the mammary gland to maintain secretion, c) that nursing by calves at foot contributes to maintenance of milk production, and d) that in absent of suckling or oxytocin milking twice daily with 6 and 18h intervals is inadequate and may induce a forced involution of the mammary glands. Milk dry matter content averaged slightly above 25% and increased slightly with stage of lactation. Dry matter consisted of about 12% fat, 9% protein and 3% lactose and the slight increase with stage of lactation was the result of increased fat and protein content of the milk.

Nye muligheter for bruk av telemedisinske løsninger i reindriften

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En evaluering av telemedisinske løsninger i human medisin for bruk i reindriften er under gjennomføring. En bedre utnyttelse av moderne IKT-løsninger kan føre til økt verdiskaping i reindriften, lette ettersyn av beitende dyr og vil i fremtiden lette vitenskaplig dokumentasjon av reinens helse og livsvilkår. Forutsetninger er at uviklingen skjer på reineiers premisser, og at man får IKT-løsninger som det er bruk for i næringen. Vi har studert ulike måter for ID-merkinger av dyr, samt fjernoverføring av kliniske data via mobil telefonnettet i Norge som vommotorikk, vom-ph, beitevalg, hjertefrekvens, hjertelyd og ultralyd bilder.

Future perspectives in use of telemedicine in reindeer husbandry

Future use of telemedicine in reindeer husbandry, developed for human medicine, are currently being evaluated. Efficient use of IKT-solutions in reindeer husbandry could improve the economy, animal welfare and handling, and make future scientific documentation of animal health easier. It is important that IKT-solutions are developed in close cooperation with the reindeer husbandry. We have investigated different concepts of identification of individual reindeer, and transmission of clinical data as rumen function, plant pasture selection, hart rate, hart sound and ultra sonic pictures by use of the mobile network in Norway.

Lungemarkinfeksjon hos rein

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Materiale og metoder
Prosjektet "Tap og dødelighet hos rein i Finnmark" (se egen poster) mottok 32 frosne reinkadaver fra flokkene A (n=18), B (n=9) og C (n=5). De døde dyrene var omkommet (n=30) eller avlivet (n=2) i perioden 3. mars til 24. mai. Dødsårsakene var underernæring (n=28) eller rovdyrskader/andre skader (n=4). Aldersfordelingen i materialet var: Kalver (9-12 mnd): n=19. Åringer (21-24 mnd): n=4. Voksne (>2 år): n=9. Det var 12 bukkekalver og 7 simlekalver. Alle åringer og voksne dyr var hunnkjønn.
Kadavrene ble undersøkt for forekomst av lungemark ved hjelp av tre metoder:

1. Makroskopisk undersøkelse: Oppklipping av luftrør og store bronkier.
2. Eggtelling i avføring: Modifisert McMaster-teknikk (utrøring i vann, sentrifugering, flotasjon av bunnfallet i saltløsning, telling i McMaster tellekammer). Deteksjonsgrense 20 epg/lpg (egg/larver per gram avføring).
3. Histologisk undersøkelse: Biter av lungevev fra lungenes hovedlapper og spisslapper ble fiksert i formalin, støpt inn i parafin, snittet, HE-farget og undersøkt i lysmikroskop.

Resultater
Makroskopisk undersøkelse (n=32): To-tre lungemarker ble funnet i de store bronkiene hos to dyr (6%) som døde hhv. 2. og 10. mai.
Eggtelling i avføring (n=31): Embryonerte egg eller frie larver i avføring, svarende til lungeormegg/larver, ble påvist hos 5 dyr (16%). Gjennomsnittlig antall: 44 epg/lpg, variasjon fra 20 til 100 epg/lpg.
Histologisk undersøkelse (n=31): Utviklingsstadier av lungemark, fra egg til larver, ble påvist hos 13 dyr (42%). Hos 6 av de 13 dyrene var det uttalte betennelsesforandringer i lungene i form av en diffus granulomatøs pneumoni.
Basert på den histologiske undersøkelsen var prevalensen av lungemarkinfeksjon hos flokk A, B og C hhv. 39%, 22% og 80%. Prevalens av infeksjonen hos kalver, åringer og voksne var hhv. 26%, 50% og 67%.
Flertallet av kalvene var behandlet med ivermektin mikstur om vinteren, tidspunktet varierte fra november til februar i de forskjellige flokkene. Lungemarkinfeksjon kunne påvises både hos behandlede og ubehandlede kalver.

Konklusjoner

- Hos de undersøkte kadavrene ga histologisk undersøkelse av lungevev et riktigere bilde av forekomsten av lungemark enn makroskopisk undersøkelse og undersøkelse for egg og larver i avføring.
- Lungemarkinfeksjon synes å være vidt utbredt i reinflokkene, men de prevalenser som framkommer i denne undersøkelsen må tolkes med forsiktighet, ettersom det meste av materialet er hentet fra dyr som har sultet i hjel på vinteren.
- Hos enkelte dyr forårsaket lungemarkinfeksjonen store betennelsesforandringer i lungene. Det er rimelig å anta at disse betennelsesforandringene kan ha betydning for dyrets overlevelse gjennom vinteren.
- Prevalensen av infeksjonen syntes å øke med alderen.
- Ivermektinbehandling på vinteren hadde tilsynelatende ingen effekt på infeksjonen.

Takk til Reindriftens Fagråd for økonomisk støtte til prosjektet.

Lungworm infection in reindeer

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Materials and methods

The project "Loss and mortality in reindeer in Finnmark" (see separate poster) received 32 frozen reindeer carcasses from herds A (n=18), B (n=9) and C (n=5). The dead animals were succumbed (n=30) or euthanised (n=2) in the period from the 3rd of March to the 24th of May. The causes of death were starvation (n=28) or predators/trauma (n=4). Age distribution was: Calves (9-12 mo): n=19. Yearlings (21-24 mo): n=4. Adults (>2 years): n=9. There were 12 male and 7 female calves. All yearlings and adults were females.

The carcasses were examined for the presence of lungworms by three methods:

4. Macroscopic examination: Trachea and the main bronchia were opened.
5. Faecal egg count: A modified McMaster technique was used (suspending faeces in water, centrifuging the suspension, suspending the sediment in a saturated salt solution, counting eggs and larvae in a McMaster counting chamber). Detection limit: 20 epg/lpg (egg/larvae per gram faeces).
6. Histological examination: Pieces of lung tissue from the cranial and caudal lobes were fixed in formalin, and paraffin embedded HE-stained histological sections were prepared. The sections were examined by light microscopy.

Results

Macroscopic examination (n=32): Two or three lungworms were found in the main bronchia in to animals (6%) that were found dead on the 2nd and 10th of May respectively.

Faecal egg count (n=31): Embryonated eggs or free larvae in the faeces, consistent with lungworm eggs/larvae, were found in 5 animals (16%). Average number: 44 epg/lpg, variation from 20 to 100 epg/lpg.

Histological examination (n=31): Different developmental stages of lungworms, from eggs to larvae, were demonstrated in 13 animals (42%). In 6 of these 13 animals there were severe inflammatory changes in the lungs, taking the form of a diffuse granulomatous pneumonia.

Based on the histological examination the prevalence in herds A, B and C was 39%, 22% and 80% respectively. The prevalence of lungworm infection in calves, yearlings and adults was 26%, 50% and 67% respectively.

The majority of the calves were treated with ivermectin mixture once during the winter, but the time of treatment varied between the herds from November to February. Lungworm infection was demonstrated in both treated and untreated calves.

Conclusions

- In winter carcasses histological examination of lung tissue gave a more reliable estimate of lungworm infection than did macroscopic examination or faecal egg count.
- Lungworm infection seem to be widely distributed in the reindeer herds, but the prevalence appearing in the present study must be interpreted cautiously, as most of the present material is taken from animals that have starved to death during the winter.
- In some animals the lungworm infection caused severe inflammatory changes in the lungs. It is reason to believe that such inflammatory changes may influence winter survival.
- The prevalence of infection seemed to increase with age.
- Treatment with ivermectin during winter did not seem to influence lungworm infection.

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Sultedød på tross av fôring – et tilbakevendende problem i praktisk reindrift

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Materiale og metoder
Prosjektet "Tap og dødelighet hos rein i Finnmark" (se egen poster) mottok 29 frosne reinkadaver som ved obduksjon fikk diagnosen ekstrem avmagring (kakeksi; se egen poster). Hos 28 av disse ble sult/underernæring ansett som direkte dødsårsak, mens det 29. kadaveret hadde, i tillegg til at det var helt avmagret, også akutte og sannsynligvis dødelige ørneskader. Dyrene stammet fra 3 forskjellige flokker, og var døde i perioden 8. mars til 24. mai. De fleste dyrene var fôret, enten ved at de var tilbudt rundballesilo som tilleggsfôr på fjellbeite, eller ved at de var tatt hjem og fôret i innhegning. Under obduksjonen ble vekta av kadaveret og vekta av vom/nettmage med innhold registrert. Prøve av vominnholdet fra 26 kadaver ble sendt til Norsk Institutt for Naturforskning, Trondheim, for analyse av botanisk sammensetning (treaktige bestanddeler, grasaktige bestanddeler, lav, mose, strø og "annet"). Prøve av vominnholdet fra 20 kadaver ble sendt til Planteforsk Holt, Tromsø, for analyse av kjemisk sammensetning (tørrstoff, aske, protein, hemi-cellulose, cellulose og lignin).

Resultater
Flokk A ble tilleggsfôret med rundballesilo på beite. Botaniske analyse av vominnhold fra 16 kadaver viste at mengden lav var liten hos alle dyr (gjennomsnitt 3,5%) Det var stor variasjon mellom dyrene når det gjaldt mengden grasaktige bestanddeler i vomma: 7 dyr hadde mindre enn 10% gras i vomma, mens 7 dyr hadde fra 47 til 76% gras i vomma. Dette tolkes slik at det er varierende i hvilken grad dyrene har tatt til seg av det tilbudte silofôret. Der hvor grasaktige bestanddeler utgjorde mindre enn 10% av vominnholdet, bestod graset i gjennomsnitt av 58% blad og 42% stengel. I de øvrige dyrene var fordelingen 17% blad / 83% stengel.
Fra flokk B ble det mottatt 8 avmagrede kadaver hvorav det forelå opplysninger om at 6 av disse var fôret med rundballesilo av havre de siste 2-4 uker. Botanisk analyse av vominnholdet viste at de 6 fôrede dyrene hadde i gjennomsnitt 90% grasaktige bestanddeler i vomma, med 12% blad og 88% stengel.
Fra flokk C ble det mottatt 3 avmagrede kalver, som alle var forsøkt fôret med silo, lav og pellets. Botanisk analyse av vominnhold viste 5-11% lav og 15-66% gras. Det grasaktige materialet inneholdt i gjennomsnitt 79% blad og 21% stengel. Hos alle disse tre kalvene ble det funnet en uttalt diffus granulomatøs lungebetennelse som følge av lungemark-angrep.
Alle flokker: Når det gjaldt kjemisk sammensetning var det en generell trend i retning av lavt protein-innhold og høyt cellulose/lignin-innhold i vomma sammenlignet med publiserte verdier. Vekta av vom/nettmage med innhold varierte sterkt, og det ble ikke funnet noen sterke sammenhenger mellom botaniske eller kjemiske parametere og vekta av vominnholdet.

Konklusjoner
Resultatene indikerer tre faktorer som kan bidra til å forklare sultedød på tross av fôring:

- Dyr som ikke tar til seg tilleggsfôr som gis på beite (flokk A).
- Bruk av grovfôr som har en lite egnet ernæringsmessig kvalitet, og gir opphopning av stengler i vomma (flokk A og B)
- Stor parasittbelastning eller parasittsjukdommer som betydelig medvirkende årsak til avmagring og død (flokk C).

Takk til Reindriftens Fagråd for økonomisk støtte til prosjektet.

Starvation death despite feeding – a recurring problem in reindeer husbandry

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Materiales and methods
The project "Loss and mortality in reindeer in Finnmark" (see separate poster) received 29 frozen reindeer carcasses, which at necropsy was given the diagnosis "extreme emaciation" (cachexia; see separate poster). Starvation was regarded as the direct cause of death in 28 carcasses, while the 29th carcase, though also cachectic, had acute and probably lethal lesions caused by eagle. The animals came from 3 different herds, and had died in the period from the 8th of March to the 24th of May. Most of the animals had been offered feed, either baled silage as supplemental feed on the mountain pastures, or different feeds in a fenced area near the home places.
During necropsy the carcase weight and the weight of ruminoreticulum with content were registered. Samples of rumen content from 26 carcasses were sent to the Foundation of Nature Research (NINA), Trondheim, for analysis of botanical composition (wooden material, grass material, lichens, mosses, litter and "other"). Samples of rumen content from 20 carcasses were sent to Planteforsk Holt, Tromsø, for analysis of chemical composition (dry matter, ash, protein, hemi-cellulose, cellulose and lignin).

Results
Herd A was given baled silage as supplemental feed on the pastures. Botanical analysis of rumen content from 16 carcasses showed that the amount of lichens in rumen was small in all carcasses (mean 3.5%). There was large variation in the amount of grass material in rumen: 7 animals had less than 10% grass material in rumen, while 7 animals had from 47 to 76% grass material in rumen. This probably expresses variation in intake of the offered silage. In animals where grass material constituted less than 10% of rumen content, the grass material consisted of 58% leaves and 42% stems (mean values), while in the other animals the grass material in rumen contained a mean of 17% leaves and 83% stems. From herd B was received 8 cachectic carcasses, of which 6 had been given baled oat silage for the last 2-4 weeks. Botanical analysis of rumen content showed that these 6 animals had a mean of 90% grass material in rumen, consisting of 12% leaves and 88% stems. From herd C was received 3 carcasses of cachectic calves, which all had been fed silage, lichens and pellets. Botanical analysis of rumen content showed 5-11% lichens and 15-66% grass material, consisting of 79% leaves and 21% stems (mean values). A severe diffuse granulomatous pneumonia, caused by lungworms, was diagnosed in these three calves.
All herds: In general, the chemical composition of rumen contents showed low content of crude protein and high content of cellulose and lignin, compared to previously reported values. The wet weight of ruminoreticulum (content included) showed large variation, and no strong associations were discovered between botanical or chemical parameters and wet weight of ruminoreticulum.

Conclusions
The results indicate three possible factors that may contribute to the explanation of starvation death despite feeding:

- Animals that do not eat from the offered feed (herd A).
- The use of roughage feed that is not suitable for reindeer, and results in accumulation of stems in rumen (herd A and B).
- Heavy parasite burden or parasitic disease that contributes significantly to emaciation and death (herd C).

Beslutsfattande inom rennäringen

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Syftet med mitt doktorandprojekt är att studera hur beslut rörande betesutnyttjande fattas inom rennäringen.
Eftersom renbete är en resurs som brukas gemensamt av flera renskötselföretagere är teorier om hur gemensamt brukade resurser långsiktigt kan utnyttjas intressanta. Oström, 1993 sammanfattar några faktorer som är viktiga för ett hållbart utnyttjande av en gemensam resurs. De är t.ex. att deltagarna är en homogen grupp med avseende på tillgångar, information, och mål. Liksom att deltagarna har samma uppfattning om problemen och hur man kan lösa dem. Inom beslutsteori kan ett beslut ses som en process som består av flera delar. Viktiga delar i beslutsprocessen är mål, problemupptäckt och problemdefinition, analys, val och implementering av lösning.
Projektet innehåller både en kvalitativ ansats med intervjuer och öppna frågor i en enkät och en kvantitativ ansats. I den kvantitativa ansatsen prövas hypoteser med hjälp av en enkät som skickats till ett urval av renskötselföretagare.
De preliminära resultaten visar att renskötselföretagarna har gemensamma långsiktiga icke-ekonomiska mål med sin verksamhet. Företagarna har valt att bli renskötare för att renskötsel var deras stora intresse och för att det var naturligt att föra en tradition vidare. Företagarna ser det också som viktigt att nästa generation fortsätter som renskötare. På kort sikt är de ekonomiska målen viktigare för renskötare som arbetar mycket inom rennäringen och har fler renar än genomsnittet än de ekonomiska målen är för renägare med få renar. Renskötselföretagarna har en likartad uppfattning och definition av problem. De största problemen bedöms vara skogsbruk och rovdjur.

Jag planerar att rapportera resultaten i en licentiatavhandling i slutet av år 2001.

Decision making in reindeer herding

The aim of my research project is to study how decisions concerning long time use of pasture are made in reindeer herding.
Since several reindeer herders use an area of pasture the theories in the field of property rights and common property regimes are interesting. Ostrom, 1993 summarizes for example conditions in decision making that will lead to a long term successful use of a commonly owned resource, some of them are that the participants is a homogenous group when it comes to preferences, and that they have the same values about what the problems are and how to solve them. In decision theory a decision can be seen as process including several events. To summaries a problem in relation to goals and values has to be identified, alternative solutions have to be recognized and a choice based on the facts about the different solutions should be made.
I have chosen two types of approaches a qualitative approach by interviews and open questions in a questionnaire and a quantitative approach where I test hypothesis by a questions in questionnaire sent to a sample of reindeer herders.
The preliminary results show that the reindeer herders have the same long term non economical goals. They choose to be reindeer herders because they saw it as a natural step to continue there parents way of life and because they saw reindeer herding as an interest. It is also important for most reindeer herders that there children will continue there business. In the short run the economical goals are more important for reindeer herders who work full time in reindeer herding and have more reindeers than the average than it is for reindeerherders with a small number of reindeers. The reindeer herders experience that the largest problems concerns forestry and predators.

I plan to have a report finished in the end of 2001.

Haihtuvien rasvahappojen kuljetus solumembraanien läpi

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Porolle ravinnon tärkein energianlähde on hiilihydraatit. Ne hajotetaan pötsin mikrobien avulla haihtuviksi rasvahapoiksi (VFA), joista poro saa 70-80% tarvitsemastaan energiasta. Pötsin lisäksi pieniä määriä haihtuvia rasvahappoja tuotetaan myös paksunsuolen käymisreaktioissa. Parillisen hiililuvun omaavia haihtuvia rasvahappoja voidaan käyttää suoraan tai hieman muokattuna energiantuottoon perifeerikudoksissa (asetaatti, butyraatti, β-hydroksibutyraatti) kun taas 3-hiilisestä propionaatista tuotetaan elimistön tarvitsemaa glukoosia glukoneogeneesillä maksassa.
Haihtuvat rasvahapot imeytyvät verenkiertoon pääosin pötsistä sekä jonkin verran myös ohutsuolesta. Happomuodossaan VFAt läpäisevät epiteelin diffuusion avulla, mutta dissosioituneessa muodossa ne tarvitsevat kuljettajaproteiinin. Monokarboksylaattikuljettaja (MCT) on useimmista kudoksista löytyvä solukalvoproteiini, joka siirtää haihtuvia rasvahappoja, ketoaineita ja maitohappoa solukalvojen läpi. Monokarboksylaattikuljettajia tunnetaan useita alatyyppejä, joista parhaiten karakterisoituja ovat MCT1, MCT2 ja MCT4. Tähän mennessä ruoansulatuskanavasta on löydetty MCT1-muotoa rotan ohutsuolesta sekä ihmisen ja sian paksusuolesta. Märehtijöiden ruuansulatuselimistön monokarboksylaattikuljettajia ei ole aiemmin tutkittu.
Tässä tutkimuksessa kartoitettiin MCT1, MCT2 ja MCT4 kuljettajien esiintymistä täysikasvuisen poron ohutsuoli- ja pötsiepiteelissä sekä maksakudoksessa. Näytteet otettiin teurastuksen yhteydessä yksilöistä, jotka olivat saaneet ympärivuotisesti joko teollista rehua tai olleet kesän luonnonlaitumella ja talven lisäruokinnalla joko tarhassa tai maastossa. Kumpaankin ryhmään kuului 8 RKTL:n Kaamasen porotutkimusaseman vaadinta.
Monokarboksylaattikuljettajien esiintyminen määritettiin kudoksista eristetyistä solumembraaneista western blot-tekniikalla.
Tutkimuksessa todettiin pötsin epiteeliltä löytyvän hyvin runsaasti MCT1 proteiinia sekä jonkin verran myös muotoa MCT4. MCT2 puuttui pötsistä kokonaan. Ohutsuolesta löytyi kaikkia kuljettajia, eniten muotoja MCT1 ja MCT4. Yksilöiden väliset erot olivat suuria erityisesti ohutsuolen kohdalla. Maksassa esiintyi myös eniten MCT1- muotoa, MCT2:n ja erityisesti MCT4:n määrän ollessa hyvin pieniä. Pötsin suuri MCT1 määrä on yhtenevä kudoksen suuren VFAn kuljetuksen tarpeen kanssa. Eri ruokintaryhmien välille ei saatu tilastollista eroa. Tuloksista voidaan päätellä monokarboksylaattikuljettajien osallistuvan haihtuvien rasvahappojen kuljetukseen poron ruoansulatuselimistössä.

Tutkimus suoritettiin Suomen Maa- ja metsätalousministeriön myöntämän apurahan turvin.

Volatile fatty acid transport across cell membranes

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The main energy source for reindeer is carbohydrate that is digested by ruminal fermentation to volatile fatty acids (VFA). It has been estimated that in reindeer 70-80% of the energy is derived from VFA. Minor quantities volatile fatty acids are produced also in cecum and colon. VFAs with even number of carbon atoms (mainly acetate and butyrate) are used for energy production in peripheral tissues. Propionate is used mainly for glucose production in the liver.
VFA are absorbed into circulation mainly from rumen and partly also from small intestine. The acid form of VFA may diffuse through cell membranes, but the dissociated form needs a transport protein. Monocarboxylate transporter (MCT) is a transmembrane protein, which transports volatile fatty acids, ketone bodies and lactate across the cell membranes. Several isoforms of monocarboxylate transporter have been found; the most extensively studied are isoforms MCT1, MCT2 and MCT4. In digestive tract MCT1 has been found in the human and pig colon and in the small intestine of rat. In ruminants monocarboxylate transporters have not been studied previously.
In this experiment the expression of MCT1, MCT2 and MCT4 in the epithelium of rumen and small intestine as well as in liver tissue was studied. Samples were collected from slaughtered adult reindeer in Reindeer Research Station at Kaamanen. Half of the reindeer (n=8) were fed a commercial feed and another half (n=8) had been grazing in the summer and was given additional feed in the winter (control group).
Monocarboxylate transporters were determined from separated cell membranes by western blotting. The results show that the main monocarboxylate transporter in rumen was MCT1. MCT4 was also present, but MCT2 was not detected. In small intestine all the transporters were detected but MCT1 and MCT4 gave the strongest signal. Individual differences were very large in the small intestine. MCT1 was the main transporter also in the liver and MCT4 and MCT2 were almost undetectable. Statistical differences were not found between the reindeer groups. The higher amount of MCT1 in the rumen than in the small intestine is in accordance with the absorption rate of VFA. These results indicate that monocarboxylate transporters have a role in VFA transport in the digestive system of reindeer.

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Luonnonlaitumet ja paimentolaistalous: esimerkkinä tiibetin ylänkö

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Laidunten määrän ja tilan tuntemus helpottaa laidunten kestävän käytön kehittämistä. Kaukokartoitus ja paikkatietomenetelmät (GIS) yhdistettynä perinteisiin laiduninventointimenetelmiin mahdollistaa laajojen alueiden tutkimuksen. Suomen poronhoitoalue on kartoitettu vuosina 1995-1998 Oulun yliopiston maantieteen ja Riista- ja kalatalouden tutkimuslaitoksen porotutkimusyksikön yhteistyönä.
Tutkimusprojekti toteutetaan yhteistyössä Kiina tiedeakatemian Chengdun biologisen instituutin kanssa. Tutkimusalue Zoige sijaitsee Sichuanin provinssissa Tiibetin ylängön itälaidalla. Ensimmäinen maastoretki Zoigeen tehtiin kesällä 2000, syyskuussa 2001 on tehdään seuraava maastoretki.
Zoigen alueen laitumia alettiin tutkia Suomessa kehitetyin menetelmin. Koska luonnonolot poikkeavat alueella huomattavasti, menetelmää kehitettiin alueelle sopivammaksi. Alueen laitumet koostuvat erilaisista ruoho-, sara- ja suokasvillisuusniityistä sekä pensaikoista. Maastopisteet kattavat alueen pääkasvillisuustyypit. Maastopisteiltä havainnoitiin kaikkien kasvilajien peittävyys sekä arvioitiin laidunnuksen voimakkuutta. Landsat TM 5 -satelliittikuva luokiteltiin maastohavaintojen avulla. Tulokseksi saatiin laiduntyyppiluokitus ja eri laiduntyyppien pinta-alat.
Luonnonlaitumet ovat Tiibetin paimentolaisten karjatalouden perusta. Jakit, lampaat ja hevoset muodostavat paimentolaisten karjan. Paimentolaiset harjoittavat hyvinkin perinteistä omavaraistaloutta. Kiinassa tapahtuva talouden ja yhteiskunnan muutos vaikuttaa myös paimentolaisten harjoittamaan karjatalouteen. Eläinmäärän kasvu saattaa alheuttaa ekologisia ongelmia kun laitumet kuluvat ja kasvisto köyhtyy. Projektissa pyritään selvittämään eri strategioita, miten paimentolaiskarjatalous selviää muuttuvassa yhteiskunnassa.
Tutkimuksen tuomat tulokset saattavat mahdollistaa suositusten antamisen mihin suuntaa karjataloutta alueella tulisi kehittää tulevaisuudessa.

Natural pastures and mobile animal husbandry management: a case study on the Tibetan plateau

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Knowledge about quality and quantity of pastures and also of the amount of natural forage resources promotes sustainable use of pastures. Remote Sensing and Geographical Information System (GIS) methods combined with traditional pasture mapping creates opportunity to study large areas resonably fast and accurate. In Northern Finland reindeer pastures have been mapped by the Geography Department of Oulu University and the Finnish Game and Fisheries Research Institute (FGFRI) during 1995-98.

A new research with a similar topic is carried out in co-operation with the Chinese Academy of Science, Chengdu Institute of Biology. The research area, Dzoge (Zoige), is located in the north-western Sichuan province on the eastern part of the Tibetan plateau. The research team visited Dzoge in summer 2000, and another field-excursion takes place in summer 2001.

Based on the research methods used in Finland an investigation on the high-altitude pastures is carried out. One objective is to adjust the research method to the environmental conditions of the new research area. The pastures consist of step- and swamp meadows with an alpine vegetation. In the research area test plots cover the main vegetation types. The coverage of plant species and the rate of degradation is measured in each plot. Basing on the Landsat TM 5 image from the area and according to field data, a classification of pasture types and degradation rate will be produced. As s final result shows a map the distribution of each pasture type and a table indicates the total coverage (in ha).

The natural pastures are used by Tibetan pastoralists as source of forage to carry out mobile animal husbandry. The livestock consists of yak, sheep and horses of which the amount in the herd composition varies regionally. The animal husbandry management is in most cases quite traditional with an essentially subsistence-based economy. According to the changing socio-economical and ecological context is the animal husbandry management subject to rapid transformations. This focus of the research project intends to elucidate the strategies with which the pastoralists respond to the changed contexts.

The findings of the research should enable us to make recommendations on the future direction of mobile animal husbandry in the region in question.

Poron vasan (*Rangifer tarandus tarandus* L.) erottamisen vaikutus imentään, maidontuottoon ja sydämen sykkeeseen koeoloissa

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Varhaisesta vasonnasta syyskuun alkukiimaan asti vuonna 2000 tutkittiin sydämen sykemittausta apuna käyttäen porokoeryhmää (4 vaadinta ja niiden urosvasat). Tarkoituksena oli tutkia eri pituisen emän ja vasan erottamisen (4, 8, 12 t) vaikutuksia. Koska emä-vasa –suhteella on tärkeä merkitys, voi häirintätapauksissa esiintyä stereotyyppisiä käyttäytymisongelmia. Ääntely (roukuminen) rekisteröitiin ja käytettiin sitä ja sydämen sykettä stressin osoittajana. Vaatimia lypsettiin juuri ennen yhdistämistä vasoihin. Sitten kirjattiin imennät, hajuun perustuvat tunnistukset ja niiden kestot. Lopuksi tutkittiin näiden tekijöiden vaikutusta vaadinten maidontuottoon.
Näyttää siltä, että pitenevän vasan erottamisen ja ääntelyn ei todettu lisäävän vasan sydämen sykettä. Sydämen syke näytti laskevan, kun erottamisaika piteni ja roukuminen lisääntyi. Vasat roukuivat enemmän ollessaan erillään 8 kuin 12 tuntia, tämä johtui tottumisesta erottamiseen. Vasat alkoivat roukua, kun ne erotettiin emistään, mutta jos emät olivat lähellä niitä naapuriaitauksessa, roukuminen väheni.
Onnistunut imentä voi tapahtua ilman hajutunnistusta osoittaen muuta tietoa, kuten näkötunnistusta, koska vasa oli yksin aitauksessa. Edelleen imetyksen kesto näytti kasvavan 8 tunnin erottamiseen saakka, mutta tasaantui 12 tuntiin mennessä erottamisen jälkeen osoittaen joko vasan tottumista erottamiseen tai fysiologista rasituksen vähenemistä. Tavallisesti mitä tärkeämpi on imentä sitä lyhyempi on sen keskimääräinen kesto ja päinvastoin. Näyttää myös siltä, että lyhyen imetyksen keston ja maidon tuoton välillä on korrelaatio. Tietysti se voi vaihdella johtuen myös yksilöllisistä eroista.
Imetyksen kesto vaihteli vasoilla 6-9 viikon iässä keskimäärin 20-40 sekunnin välillä. Imentäkerrat/tunti vaihtelivat välillä 0,7-1,8 pois lukien yksi poikkeava vaadin.
Fysikaalisista tekijöistä lämmin sää ja myös sääsket lisäsivät imentäkertoja mutta vähensivät imentöjen keskimääräistä kestoa. Sateella oli päinvastainen vaikutus. Se näytti häiritsevän emä-vasa –suhdetta. Lopuksi näyttää siltä, että ei ihmisen läsnäolo, porojen käsittely eikä läheiset kontaktit vaikuta imentään, tämä johtuu mahdollisesti tämän lajin kesystä luonteesta.

The effect of separation of reindeer calf (*Rangifer tarandus tarandus* L.) on suckling events, milk yield and heart rate under experimental conditions

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From the early calving season up to the pre-rut period in September 2000, an experimental group (4 females and their male calves) was equipped with heart rate monitors. The aim was to analyse the effects of partial separation of mother and calf at different time periods (4, 8, 12 h). Indeed, the female-calf bound plays a particularly important role, and in case of disruption, some troubles like stereotypes might appear. Thus, vocalisations emitted (grunts) and heart rate were recorded and used as alerting signals to show the stress impact. Females were milked artificially just before reunion. Subsequently, suckling events were observed: olfactory recognition, mean lasting and their occurrence. Finally, the impact of measured factors on average milk yield per female was studied.
It appears that, heart rates are not affected by grunts by the increase in hours of separation. Heart rate tend to decrease with separation time while grunts increase. Calves grunt more if separated for 8 hours than for 12 hours, which expresses habituation to separation. Thus, calves start grunting when separated from their mother, but curiously, if females were nearby them in the neighbouring fence, it started to decrease.
Successful suckling can occur without olfactory recognition showing there's another source of information, which is visual, because the calf is alone in presence of his mother in corral. Furthermore, concerning lasting of suckling events, they tend to increase for 8 hours of separation, but reach a stable point after 12 honrs of separation for all cases, expressing either habituation to separation or a physiological parameter such as reducing strength. Commonly, the more the occurrence of suckling is important and the more the mean lasting is short and the contrary. It seems also that there is a correlation between short lasting of suckling and a low milk yield. Of course, it may vary according to individual differences.
The mean lasting suckling for calves between 6 and 9 weeks old varies from 20 to 40 sec. Suckling frequency per hour varies between 0,7 and 1,8 by excluding one female.
According to physical parameters, it appears that under warm weather and high mosquito density, we have a suckling frequency which inereases and a mean lasting reducing. During rain, we can notice the reverse. It appears as a disruption in mother - calf contacts. Finally, it seems that neither the presence of human, handling of reindeer nor the close contact while observing them affects the suckling unfolding, probably due to the tame feature of this species.

Slakteforskrifter for reinsdyr og oppdrettsvilt kontra viltkjøtt forskrifter – fordypningsoppgave ved NVH

Eli Ristin Nergård
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Oppgaven vil omfatte sammenligning av krav til hygiene og kontroll ved behandling av vilt i forhold til reinsdyr og oppdrettsvilt, herunder produksjon, lagring, transport, frambud og dyrevernsmessige aspekter.
Forskjeller, likheter og konsekvenser av forskriftene skal videre vurderes i forhold til leverandører, praktisk kjøttkontroll og det kommunale næringsmiddeltilsynet (KNT).
Paralleller og sammenligning med regelverk i våre naboland (EU og Russland), særlig når det gjelder import/ eksport av kjøtt og levende dyr.

The slaughterhouse law of reindeer and breeded game, compared to the law of game meat – a degree project at NVH

A comparison study of the demands of the law, to foodhygiene and control with handeling of game compared to reindeer and breeded game, which includes production, storing, transport, offering and the perspectives of animal protection.
Differences, similarities and concequenses of the laws will be discussed in relationship to the producers, practical meatinspection and the local foodhygiene departments.
The laws in our neighbour countries (EU and Russia) will be discussed and compared to the Norwegian laws, and compared in relationship to import/ export of meatproducts and live animals.

Effekt av foderstat på vommikroorganismer i renar

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Anpassning av vommen till olika foderstater efter en period av begränsat foderintag studerades hos renar (*Rangifer tarandus tarandus*) under vintern. All vomdata baseras på resultat från slaktade djur. Fyrtiofyra åtta månader gamla honrenar utfodrades initialt med en simulerad vinterdiet (lavdiet). Renar som kontinuerligt utfodrats med lavdieten *ad lib.* jämfördes med renar som hade fått ett reducerat foderintag (halva mängden jämfört med *ad lib.* under 8 dagar, följt av total svält under en dag). De renar som haft ett reducerat foderintag hade mindre mängd vominnehåll med högre pH, lägre torrsubstanshalt, lägre koncentration av flyktiga fettsyror och färre bakterier och protozoer. Effekten var dock inte så uttalad som vad som rapporterats för renar utsatta för total svält. Under den följande femveckorsperioden utfodrades en grupp åter med lavdieten *ad lib.* och djuren i denna grupp visade inga tecken på störd vomaktivitet, men uppvisade en svagt negativ viktutveckling. Tre andra grupper utfodrades med pelleterat spannmålsbaserat renfoder, antingen kombinerat med lav eller gräs-ensilage, eller utfodrades med ensilage med en gradvis ökad inblandning av pellets. Initialt förekom hälsoproblem med diarré och avmagring, vilket ledde till förluster av djur. De återstående djuren verkade dock anpassa sig till den nya foderstaten och kroppsvikterna ökade något. Utfodringsstrategierna resulterade i ett minskat vominnehåll med högre torrsubstanshalt och koncentration av flyktiga fettsyror, samt en ökning av antalet protozoer. Lav-utnyttjande bakterier minskade drastiskt då lav inte ingick i foderstaten och dessa bakterier kunde därför klassificeras som en substrat-specifik grupp. Då inga cellulolytiska bakterier kunde påvisas hos renarna försvårades sannolikt utnyttjandet av ensilage. Antalet protozoer minskade under utfodringstiden på foderstater utan lav och indikerade att protozoer kan reflektera en störd vommiljö.
Renar verkar vara anpassade till kortare perioder med otillräckligt foderintag, även om vomaktiviteten påverkas negativt. Naturliga fodermedel som lav kan återställa vomekologin bättre än spannmåls- eller ensilage-baserade foderstater.

Dietary effects on rumen microbes in reindeer

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Rumen adaptation to various diets after restricted feed intake and starvation was studied in reindeer (*Rangifer tarandus tarandus*) during winter. All data was based on data from slaughtered animals. Forty-four eight-month-old female reindeer were initially fed a simulated winter diet (lichen diet). Animals continuously offered the lichen diet *ad lib.* were compared with restrictively fed reindeer (given half of the *ad lib.* ration for eight days followed by one day of starvation). The restrictively fed animals had less rumen content, with higher pH, lower dry matter and volatile fatty acid concentration and also lower counts of bacteria and protozoa, but the effect was less dramatic than reported from totally starved reindeer. During a following five-week period, one group was re-fed the lichen diet *ad lib.* and the animals in this group showed no sign of disturbed rumen activity, but had a negative body weight trend. Three other groups were fed pelleted grain-based reindeer feed, combined with either lichens or grass silage, or fed silage with a gradually increasing addition of pellets. Initially, health problems occurred with diarrhoea and emaciation, leading to loss of animals. However, the remaining reindeer seemed to adapt to the diet and the body weights slightly increased. The feeding strategies resulted in less rumen content, with higher dry matter and volatile fatty acid concentration and higher count of protozoa. Lichen utilizing bacteria, were drastically reduced when lichens were lacking in the diet, and these bacteria could thus be classified as a substrate specific group. No cellulolytic bacteria were found in the reindeer and problems utilising the silage thus occurred. The number of protozoa decreased over time on the lichen diet and was low in euthanised animals, indicating that protozoa may reflect unsuitable rumen conditions.
Reindeer appear to be adapted to shorter periods of inadequate feed intake, even though the rumen activity seems to be negatively affected. Natural feed sources like lichens can restore the rumen ecology better than grain- or silage based diets.

Poron ravintokasvien, -sienien ja -jäkälien maittavuus ja ravintosisältö

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Vuodenaikojen vaihtuminen säätelee poron ravinnon saatavuutta ja laatua luonnonolosuhteissa. Kasvukauden alussa alkukesällä poron käyttämien ravintokasvien ravintoarvot ovat parhaimmillaan: valkuaista on runsaasti, kuitua vähän. Kesän kuluessa kasvien ravintoarvot yleisesti heikkenevät, mutta niiden alueellisessa sukkessiossa on vaihtelua siten, että esim. tuntureiden varjoisemmilla rinteillä ja lumenviipymäpaikoilla kasvien ravintoarvot säilyvät pitempään porolle suotuisina. Myös kasvien kasvumuotojen ja ravintoarvojen suhteen tapahtuu eri lajien välistä ajallista vaihtelua. Poro siirtyy vuodenaikojen vaihettumisen mukaan alueille, joilla kulloinkin on saatavilla paraslaatuisinta ravintoa. Se kuuluukin ravinnonvalintastrategialtaan ns. välityyppisiin märehtijöihin, joille ravinnon laatu on tärkeämpää kuin sen määrä. Valikoivuudestaan huolimatta, tai juuri sen ansiosta, poro kykenee käyttämään pohjoisen luonnon tarjoamia ravintoresursseja – kasveja, sieniä ja jäkäliä – tehokkaasti hyväkseen.

Poron luonnossa käyttämien ravintokasvien maittavuuseroista on tehty vain muutamia kokeellisia tutkimuksia. Käsitykset poron käyttämien ravintokohteiden suosituimmuudesta ovat pitkään perustuneet kokemusperäiseen tietoon, johon nojaten onkin mielenkiintoista verrata kokeellisesti saatuja tuloksia. Tutkimuksissamme, jotka olemme suorittaneet Paliskuntain yhdistyksen Kaamasen porokoetarhalla, olemme tarjonneet poroille samanaikaisesti useita poron ravinnokseen käyttämiä kasvi-, sieni- ja jäkälälajeja, ja seuraamalla porojen ravinnonvalintaa koeolosuhteissa luokitelleet tarjotut ravintokohteet paremmuusjärjestykseen maittavuuden suhteen. Näissä ns. cafeteria-kokeissa on ollut kokeesta riippuen 6-15 vaadinta kerrallaan, muutamissa yksittäisissä kokeissa myös vasat ovat olleet emiensä mukana. Vertailtavat lajit on tarjoiltu samanlaisista muoviastioista useina (3-5) toistoina samoille poroille ja astioiden järjestys on arvottu toistojen välillä. Yksittäisissä kokeissa on vertailtu 4-8 eri lajia kerrallaan, mutta myös parittaisia vertailuja on tehty. Kokeissa käytettyjen lajien ravintoainekoostumus on selvitetty joko aiemmista tutkimuksista tai puuttuvien tietojen osalta teettämällä ko. lajeille rehuanalyysi.

Kaamasessa kesäaikaan suoritetuissa maittavuuskokeissa suosittuja kasvilajeja ryhmissään olivat mm. tunturi- ja vaivaiskoivu, mustikka, mesiangervo, hilla ja juolukka. Myös suolaheinä, nurmitatar, rönsyleinikki, maitohorsma, väinönputki, kangasmaitikka ja metsäkurjenpolvi maistuivat hyvin koeporoille. Kurjenjalka, raate ja järvikorte olivat maistuvimmat lajit omassa ryhmässään. Syksyllä sienistä maittoivat parhaiten tatit ja yllättäen punakärpässieni saavutti toisen sijan haperoiden jäädessä kolmanneksi. Jäkälistä parhaiten maistuivat harmaa- ja palleroporonjäkälä. Useissa eri kokeissa ilmeni, että poronjäkälät olivat maittavampia kuin lupot, niin syksyllä kuin keväälläkin. Luppo oli kuitenkin suositumpaa kuin tatit. Eri puilla kasvavista lupoista testattiin koivulla, männyllä ja kuusella kasvavien luppojen suosituimmuus. Koivun ja männyn lupot maistuivat koeporoille hieman paremmin verrattuna kuusenluppoon. Kevättalven ravintona testattiin maittavuuseroja myös sammalien välillä. Muutama koeporo söi seinäsammalta ja kynsisammalta kun taas metsäkerrossammal ja karhunsammal eivät kiinnostaneet ollenkaan. Yksi koeporo söi jopa koko tarjolla olleen seinäsammalannoksen. Huomioitavaa kaikissa tuloksissa on, että koeporoja ei pidetty ravinnotta ennen kokeita, vaan ne olivat normaalissa ravitsemustilassa. Näin haluttiin säilyttää poron luonnollinen valikoivuus koeoloissa. Vasonta-aikana testattiin ko. aikana saatavilla olevia ravintokohteita ja maittavuusjärjestykseksi saatiin metsälauha, variksenmarja, sara, puolukka, mustikka, kynsisammal, seinäsammal ja tupasvilla. Tupasvillan heikko maittavuus kahdessakin eri kokeessa jäi mietityttämään, joten jatkotutkimuksilla näyttäisi vielä olevan sijansa poron ravinnonvalinnan selvittämisessä.

Palatability and nutrient composition of plants, fungi and lichens foraged by reindeer

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Reindeer is known to select always the best quality forage available. Since both quality and availability of forage species change during the year, reindeer variably feeds on different plant, mushroom and lichen species depending on season. During the early growing season the nutrient values of forage species are at their best: high in protein, low in fibre. During summer the nutrient values generally deteriorate. However, there are differences in spatial succession of forage species, e.g. the quality of species as forage for reindeer retains longer on northern and shady fjell slopes. Taking account temporal variation in growth forms of different species there is continuously high quality food available. Reindeer follows these changes in the vegetation succession and seeks for new grazing areas accordingly. In the grazer - concentrate selector continuum reindeer is classified as an intermediate ruminant being both opportunistic and adaptable selector in its' feeding strategy. This strategy, indeed, is essential for utilizing the natural forage resources – plants, fungi and lichens – with the highest possible efficiency taking account the physiological requirements for surviving in the North.

There are only few empirical experiments made on the palatability differences of natural forage of reindeer. The current understanding on the forage selection and preference ranking of forage species has so far considerably relied on traditional knowledge, which however provides essential background data for study design and enables comparisons to obtained new results. To examine the preference, i.e. differences in palatability, of some species of plants, fungi and lichens commonly found on natural pastures in Finland, we carried out a series of cafeteria-trials from 1994-97. A group of hinds (n=6-15) acted as "cafeteria-jury", which was served with different forage species (4-8 at the time per trial) equally. Each individual hind was served for 5 minutes, and the choices were observed in a qualitative basis. In some trials also calves accompanied their respective mothers. The procedure was replicated 3-5 times and for each replication the order of species served was randomized. The order of preference was arranged using the palatability index. The palatability experiments were carried out at the Experimental Field Station of the Reindeer Herders' Association in Kaamanen, Northern Finland. To relate obtained preferences of given species to their nutritive values we also analyzed the chemical composition of several species. For many species chemical composition has been presented in earlier studies, and could be extracted from the litterature. The aim of this study was to describe seasonal diet preferences of reindeer, and to discuss seasonality and quality of forage.

During summer preferred forage species in their respective trials were mountain birch, dwarf birch, blueberry, meadowsweet, cloudberry and northern bilberry. Also common sorrell, viviparous knotweed, creeping buttercup, fireweed, garden angelica, common cow-wheat and crawflower were palatable for reindeer. Marsh cinquefoil, bogbean and water horsetail were the most preferred species in their respective group. Boleti were highly preferred among fungi in September, but interestingly also fly agaric amanita was palatable. In October the most palatable lichen species were reindeer lichens (*Cladina* sp.) while *Stereocaulon* was obviously very unpalatable. Reindeer lichens were more palatable than arboreal horsetail lichens both in early winter and spring. While serving some moss species in spring some reindeer ate small amounts of Red-stemmed feather moss and *Dicranum*. During calving time reindeer selected hair grass, crowberry, sedges, lingonberry and blueberry, but didn't eat early stage buds of offered cotton grass (*Eriophorum vaginatum*), which was presumed to be preferred spring forage for reindeer.

Vasatuoton ja –kuolleisuuden arvioinnissa käytetyt menetelmät

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Vasatuotto on nykyään harjoitettavan poronhoidon kannattavuuden kannalta tärkeä tekijä. Sillä tarkoitetaan teuraserotuksissa laskettujen vasojen suhdetta vaatimien lukumäärään. Vasa-kuolleisuus puolestaan on yksi tärkeimmistä vasatuottoon vaikuttavista tekijöistä. Siihen, kuinka paljon vasoja voidaan syystalvella teurastaa ja mikä on vasojen keskipaino, vaikuttavat monet tekijät jo vasontaa edeltävästä kesästä lähtien. Jopa aiempien vuosien olosuhteilla voi olla vaikutuksia vasatuottoon. Vaatimien kunnon ja painon on todettu vaikuttavan merkittävästi vasojen syntymäpainoihin ja siten myös niiden selviytymiseen ja teuraspainoihin. Myös vaatimen ikä vaikuttaa vasojen selviytymiseen siten, että nuorilla vaatimilla on suurempi riski menettää vasansa kuin vanhemmilla ja kokeneemmilla vaatimilla. Vaatimen ikä ja paino tosin korreloivat, etenkin nuorimmissa ikäluokissa. Yksittäiset muuttujat eivät yleensäkään pysty selittämään hyvin vasatuotossa ja –kuolleisuudessa esiintyvää vaihtelua. Vaatimen ominaisuuksien lisäksi vasojen selviytymiseen ja painonkehitykseen vaikuttavat monet muutkin tekijät. Näitä vasatuottoon ja vasojen kuolleisuuteen vaikuttavia tekijöitä voidaan tutkia joko suorilla tutkimusmenetelmillä tai tutkimalla esim. paliskuntien luku- ja merkintävelvollisuuteen perustuvia vuosittaisia tilastoja, ns. poroluetteloita. Niinikään voidaan hyödyntää säätilastoja ja paikkatietojärjestelmiin kerättyä tietoa maankäytöstä, laitumista ja porojen liikehdinnästä. Laiduntilanteen, lisäruokinnan määrän ja laadun sekä paikallisen poronhoitotavan tunteminen on välttämätöntä tulosten ymmärtämisen kannalta. Myös petoeläinten ekologia tutkimusalueilla tulisi tuntea mahdollisimman hyvin.

Tutkimukset porokannan tuottavuudesta ja siihen liittyvästä vasatuotosta ovat usein perustuneet virallisiin porotilastoihin, joiden tietoja on suhteutettu sääolosuhteisiin tai maasto-tutkimuksin ja kaukokartoituksella kerättyyn laiduntietoon. Porojen yksilölliseen merkintään perustuvia tutkimuksia on Suomessa suoritettu Paliskuntain yhdistyksen Kaamasen porokoe-tarhalla ja yksittäisinä tutkimuksina eri paliskunnissa. Vasojen selviytymistä on selvitetty merkitse-mällä vasat yksilöllisesti tunnistettavilla korvapiltoilla tarhavasotuksen yhteydessä tai vasanmerkin-nöissä. Vasojen perustiedot kuten paino, sukupuoli ja väri ovat olleet perusmuuttujia näissä tutkimuksissa. Paliskunnissa suoritetuissa tutkimuksissa on kuitenkin harvoin voitu yksilöllisesti merkitä vasatuotannon perusyksikköä, vaadinta, ja yhdistää merkityn vasan tiedot emän ominaisuuksiin. Niinikään pelkkä vasojen yksilöllinen merkintä ei ole riittävästi kyennyt selvittämään mistä mm. vasojen kesäaikainen kuolleisuus johtuu. Radiotelemetriatekniikan käyttö tutkimuksissa on tuonut huomattavasti uutta tietoa vasojen kuolinsyistä ja niiden selviytymiseen vaikuttavista tekijöistä. Ns. kuolevuusradiolähettimet otettiin Suomessa käyttöön vuonna 1997, josta lähtien Suomen poronhoitoalueella on toistaiseksi kolmessa eri paliskunnassa merkitty yhteensä 1 325 vasaa. Parhaillaan meneillään olevassa tutkimuksessa on vuodesta 1999 alkaen merkitty kahdeksassa eri paliskunnassa yksilöllisesti yli 2 000 vaadinta, joiden ominaisuudet on selvitetty mittauksilla ja punnituksilla. Näiden tutkimusvaadinten vasontamenestystä ja vasojen selviytymistä teurastuskauteen asti on seurattu. Vasakuolleisuuden suuruuden ja syiden selvittämisen lisäksi erityistä huomiota on kiinnitetty vasatuottoon vaikuttaviin poronhoito-tapoihin kuten lisäruokinnan määrään ja laatuun. Myös vaatimien laiduntenkäyttöä ja liikehdintää on seurattu GPS-tekniikan avulla hyödyntäen paikkatietojärjestelmiin tallennettuja maastotietoja tutkimusaineistona. Jatkossa olisi ekologisten vuorovaikutussuhteiden tarkemman tuntemuksen kannalta tärkeää myös petoeläinten, niin suurpetojen kuin maakotkien, seuranta tutkimusalueilla. Tulevaisuuden haasteet liittyvätkin eri tutkimusmenetelmien yhdistämiseen ja siten vasatuottoon ja –kuolleisuuteen liittyvien tekijöiden yksityiskohtaisempaan selvittämiseen.

Methods in assessing reindeer calf production and mortality

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Calf production is a very important factor in current reindeer husbandry. In practice it expresses the proportion of calves per 100 hinds counted in the slaughter seasons' round-ups. Calf mortality, on the other hand, is one of the most important factors affecting calf production. Many factors have effect on calf production, i.e. how many calves there will be for slaughtering and what is the mean slaughter weight of calves. Conditions already since previous summer prior to birth of calf, even conditions during earlier years, may affect calf production. The body condition and weight of hinds has been shown to affect the birth weight of calves and, thus, also the survival and slaughter weights of calves. The age of hind is also an important factor those calves born for young hinds being more vulnerable for mortality. However, age and weight correlate in the youngest year-classes of hinds, which complicates the analysis. In general, any single factor can't sufficiently explain the variation observed in the calf production and mortality. In addition to the factors related to the characters of hind there are several others affecting the survival of calves and their weight gain during summer. These factors may be approached by using direct study methods on the field or by doing research on the official statistics on reindeer numbers and productive measures. Also weather statistics and data collected into Geographical Information System (GIS) may be utilized. Data on the pasture areas, land management, habitat selection of reindeer and local ways of practicing reindeer husbandry, including supplementary feeding, are essential information in studying and understanding calf production. Also the ecology of predators in the study area should be known as well as possible.
Studies on the productivity of reindeer stock and related calf production have often been based on the use of official statistics, which data has been related e.g. to the weather information or pasture characteristics obtained through pasture inventories and satellite mapping. Studies based on marking of individuals have been carried out at the Experimental Field Station of Reindeer Herders' Association in Kaamanen, and also in reindeer herding co-operatives. Survival of calves has been monitored by tagging them with individually numbered ear-tags in the calving corrals or in the summer round-ups. Weight, sex and color of the calf are the most common factors recorded in conjunction with tagging. However, in the studies carried out in the reindeer herding co-operatives the reproductive unit, the hind, has seldom been studied or marked for individual recognition enabling later association of data on calf and hind. Individual collaring of hinds gives valuable information on reproduction and combined with ear-tagging of their calves offers more factors for studying survival. On the other hand, plain ear-tagging of calves cannot explain the causes of calf mortality. Radiotelemetry as a study method has provided considerably amount of new information on the causes of calf mortality and on the factors affecting survival of calves. Mortality transmitters were taken in use in Finland during 1997. Since that altogether 1 325 calves have been marked with radiocollars in three different locations. In the current research project starting in 1999 altogether 2 000 hinds have been individually collared in eight different reindeer herding co-operatives and the reproductive performance and calf survival of these hinds has been observed. The hinds have been studied by weighing and measuring. The survival of the calves with respect to calf characteristics has been observed as well. Also GPS and GIS techniques have been used to monitor pasture use of hinds. Supplementary feeding and local ways of reindeer herding have been paid special attention. To better understand the complex ecological interactions also studies on predators, both terrestrial and avian, on the same study sites would be essential. The challenge for the future will be combining all different study methods for obtaining detailed data on the interactions affecting calf production and calf mortality.

Ernæringsmessige effekter av fôring på blodparametre i rein

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Ti grupper oksekalv av rein (*Rangifer tarandus tarandus*) (3 dyr i hver gruppe) ble gitt fôr med varierende kvalitet i 4-5 uker. Det ble deretter tatt blodprøver som ble analysert for enzymer, metabolitter, mineraler og elektrolytter. Dette ble gjort for å undersøke hvorvidt slike blodparametre kan brukes for å vurdere ernæringsstatusen til dyr i en praktisk fôringssituasjon. Syv ulike kvaliteter surfôr av gress (enten *Phleum pratensis* høstet på ulike vekststadier, *Poa pratensis* eller *Festuca pratensis*), høy av *P. pratensis*, lav (*Cladonia stellaris*) og pelletert reinfôr (RF-80) ble brukt. Det ble også inkludert blodprøver fra tre dyr som ble hentet direkte fra et naturlig vinterbeite. Glukose nivået i blod varierte mellom 1.5 and 8.0 mmol/l (n=33), og var positivt korrelert med daglig inntak av råprotein (n=29, R^2=0.26, p<0.05) og levervekt (n=33, R^2=0.28, p<0.05), og negativt korrelert med den samlede størrelse av nettmage og vom (n=33, R^2=0.32, p<0.05). Serum natrium korrelerte også positivt med parametre på kroppssammensetning (slaktevekt og levervekt) som ofte brukes til å bestemme ernæringstilstanden til dyret, mens serum enzymet aspartataminotransferase korrelerte negativt med slaktevekten til dyrene (n=33, R^2=0.36, p<0.05). Serum totalprotein (R^2=0.37, p<0.05), albumin (R^2=0.42, p<0.05), kalsium (R^2=0.44, p<0.05) og magnesium (R^2=0.30, p<0.05) korrelerte alle positivt med daglig inntak av nitrogen hos fôrede dyr (n=29). Totalprotein i serum var negativt korrelert med størrelsen på nettmage-vom (n=33, R^2=0.32, p<0.05), albumin korrelerte positivt med lever størrelse (n=33, R^2=0.27, p<0.05) og triglyserider positivt med slaktevekt (n=33, R^2=0.25, p<0.05). Vi konkluderer derfor med at analyser av disse blodparametrene egner seg til å bestemme ernæringstilstanden til rein i en fôringssituasjon der en bruker ulike typer fôr.

Nutritional effects of artificial feeding on serum biochemistry in reindeer

Ten groups of male reindeer (*Rangifer tarandus tarandus*) calves (n=3 in each group) were fed diets of different qualities for 4-5 weeks. Blood samples were collected and analysed for enzymes, metabolites, minerals and electrolytes at the termination of the feeding trial. This was done to evaluate if serum biochemistry could be used to assess the nutritional status of the animals. Seven different qualities of grass silage (either *Phleum pratensis*, *Poa pratensis* or *Festuca pratensis*), hay of *P. pratensis*, lichen (*Cladonia stellaris*) and pelleted commercial feed were used. Blood samples from three animals taken directly from natural winter pasture were also included for comparison. Blood glucose ranged between 1.5 and 8.0 mmol/l (n=33), and was positively correlated with daily intake of crude protein (n=29, R^2=0.26, p<0.05) and liver size (n=33, R^2=0.28, p<0.05), and negatively correlated with the size of the reticulo-rumen (n=33, R^2=0.32, p<0.05). Serum sodium correlated positively with body composition parameters (carcass weight and liver size) often used to determine the nutritional status of the animal, while the serum enzyme asparate aminotransferase correlated negatively with the carcass weight of the animals (n=33, R^2=0.36, p<0.05). Serum total protein (R^2=0.37, p<0.05), albumin (R^2=0.42, p<0.05), calcium (R^2=0.44, p<0.05) and magnesium (R^2=0.30, p<0.05) were all positively correlated with daily intake of protein in the fed animals (n=29). Serum total protein was negatively correlated with the size of the reticulorumen (n=33, R^2=0.32, p<0.05), albumin correlated positively with liver size (n=33, R^2=0.27, p<0.05) and triglycerides correlated positively with carcass weight (n=33, R^2=0.25, p<0.05). Consequently, the above serum parameters are suitable to determine the nutritional status of artificially fed reindeer.

Eksperimentell oppvarming av beiteplanter for rein *in situ* øker produksjonen av planter

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Årlig variasjon i levende vekter hos rein er korrelert med klimafaktorer som temperatur om sommeren. Likeledes er veksten til planter i nordlige områder også påvirket av klima. Vi har undersøkt hvilken effekt kunstig oppvarming av omgivelsestemperaturen har på veksten av beiteplanter for rein i løpet av en sommer i Nord-Norge. Dette ble gjort for å teste hypotesen at i kjølige omgivelser som dette vil en beskjeden økning i temperaturen øke netto overjordisk primær produksjon (NPP). Fjellvegetasjon (500 m.o.h.) ble varmet opp fra juli til september 2000 med hjelp av åpne oppvarmingskammer (open topped chamber/OTC) som hver dekket et areal på ca. 1.3 m^2. Syv OTC og syv ikke oppvarmede kontrollfelt ble plassert parvis i et tilfeldig blokk design inni et gjerde som målte 30 x 30 meter. OTCene ble satt opp omtrent en uke etter snøsmelting og stod på samme plass gjennom hele vekstesongen. Temperatur ble målt og registrert en gang i timen gjennom hele sommeren 5 cm over bakkenivå i tre OTC og i tre kontrollfelt. Karplanter ble høstet fra en nytt kvadrat (25 x 25 cm) i hver OTC og i hvert kontrollfelt fire ganger i løpet av sommeren. Plantene ble sortert artsvis og delt inn i årets og tidligere års vekst. Alt materiale ble tørket ved 55 °C i 24 t og veid til nærmeste 0.001 g. Gjennomsnitts temperaturen for sommeren var høyere i de oppvarmede feltene (12.4 °C) sammenlignet med kontrollfeltene (10.9 °C; $P<0.01$). Differansen mellom temperaturer i OTCene og i kontrollfeltene varierte fra + 3.9 °C til + 0.3 °C. NPP av karplanter (alle arter samlet), beregnet fra den siste høstingen som ble gjennomført i september, var 31.4% høyere i OTCene en i kontrollfeltene ($P<0.1$). Spesifikk NPP av *Vaccinium myrtillus* var 24.9% høyere i OTCene enn i kontrollfeltene ($P<0.01$). Det skal gjøres videre analyser for å undersøke om den registrerte økningen i biomassen av *Vaccinium myrtillus* i OTCene representerer en økning i stående biomasse av viktige næringsemner tilgjengelig for reinen eller kun en økning i biomassen av de strukturelle delene i planter.

Experimental warming of reindeer forage plants *in situ* increases their growth

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Between year variation in the live body mass of reindeer is strongly correlated with climate variables such as temperature in summer. Likewise, the growth of plants in northern habitats is modulated, at least in part, by the climate. We investigated the effect of an artificial increase in ambient temperature on the growth of reindeer forage plants throughout one summer in northern Norway to test the hypothesis that in a cold environment like this a small increase in temperature would increase net above ground primary production (NPP). Temperature was manipulated over tundra plots (500 m.a.s.l) from July to September 2000 using open topped chambers (OTC) which each covered an area of approximately 1.3 m^2. Seven OTCs and seven unwarmed plots were assigned in a pairwise randomised block design within a 30 x 30 m exclosure. The OTCs were established approximately one week after snowmelt and were left in place for the whole growing season. Temperature was measured and recorded at hourly intervals throughout the summer at 5 cm above ground in three OTCs and in three control plots. Vascular plants were harvested from one new quadrat (25 x 25 cm) in each OTC and each control plot four times during the summer. The plants were sorted by species and divided into current and previous years' growth. All material was dried at 55 °C for 24 h and weighed to 0.001g. The mean temperature over the summer was higher in the warmed plots (12.4° C) compared to the control plots (10.9° C; $P<0.01$). Differences between mean temperatures in the OTCs and the control plots varied from +3.9° C to +0.3° C. The NPP of vascular plants (all species combined) measured at the final harvest in September was 31.4% higher in the OTCs compared to the control plots ($P<0.1$). The specific NPP of *Vaccinium myrtillus* was 24.9% higher in warmed plots compared to control plots ($P<0.01$). Analysis is under way to determine whether the increase in biomass of *Vaccinium myrtillus* in the OTCs represented an increase in the standing crop of important nutrients available for reindeer or merely an increase in the biomass of structural elements in the plants.

Lihasten valkuaisaineaineenvaihdunta kaupallisella rehulla ruokituissa ja rajoitetulla jäkäläruokinnalla olleissa poronvasoissa talvella

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Vapaasti laiduntavien porojen valkuaisaineaineenvaihduntaa rajoittaa talvella jäkälän, porojen tärkeimän energialähteen, matala typpipitoisuus. Poron aineenvaihdunta on erittäin hyvin sopeutunut vuodenaikaisvaihteluun, mikä typpiaineenvaihdunnan osalta näkyy alentuneena urean erityksenä virtsaan ja toisaalta tehostuneena urean kierrätyksenä uudelleenkäytettäväksi pötsiin. Valkuaisaineiden muodostusta elimistössä säätelee niiden synteesi- ja hajoamisnopeudet, joissa tapahtuvista vuodenaikaismuutoksista tiedetään erittäin vähän. Tämän tutkimuksen tarkoituksena oli vertailla lihaskudoksen valkuaisaineaineenvaihduntaa poronvasoissa, joita ruokittin joko kaupallisella rehulla tai jäkälällä. Valkuaisaineaineenvaihduntaa seurattiin mittaamalla lautaslihaksen (M. gluteus medius) lihassolujen poikkileikkauspinta-alat sekä katepsiini B aktiivisuus, jota käytettiin kuvaamaan proteiinien hajoamisnopeudessa tapahtuvia muutoksia.
Koe tehtiin Paliskuntain yhdistyksen koetarhalla Kaamasessa ja kummassakin ryhmässä oli 8 urosvasaa. Rehuryhmän vasat saivat koko kokeen ajan vapaasti kaupallista rehua. Jäkäläryhmän vasat saivat tammikuun lopusta 5 viikon ajan vapaasti jäkälää, jonka kulutus mitattiin. Tämän jälkeen jäkälämää vähennettiin asteittain niin, että kahden viikon kuluttua vasoille annetun jäkälän määrä oli 60% niiden vapaasti syömän, kokeen alussa määritetyn, jäkälän määrästä. Kaupallisen rehun energiamäärä oli 19.8 MJ/kg kuivapainoa ja jäkälän vastaava arvo on 10.2 MJ/kg. Raakavalkuaisen ja raakarasvan määrät kaupallisessa rehussa olivat 10.2 ja 3.9% ja jäkälässä 2.6 ja 2.5%. Biopsianäytteet otettiin marraskuussa, tammikuussa ja kokeen lopussa huhtikuussa.

Katepsiini B aktiivisuus aleni kaikissa vasoissa marraskuusta tammikuuhun ja pysyi sitten tällä matalalla tasolla huhtikuun loppuun saakka. Ruokintaryhmien välillä ei ollut tialstollisesti merkittäviä eroja. Tämä tulos osoittaa, että valkuaisaineiden hajoamisnopeus hidastui vasojen lihaksissa ruokinnan laadusta tai määrästä riippumatta. Lihasten solukoostumuksessa ei tapahtunut muutoksia talven aikana, eikä ruokintaryhmien välillä ollut mitään eroja. Jäkäläryhmän lihassolujen poikkileikkauspinta-aloissa ei tapahtunut muutoksia marraskuusta huhtikuuhun, kun taas rehuryhmässä samalla ajanjaksolla lihassolujen, ennenkaikkea tyyppien I ja IIA, poikkileikkauspinta-alat suurenivat. Koska lihassyiden poikkileikkauspinta-alan pienenemisen on aikaisemmassa tutkimuksessa arveltu osoittavan lihasvalkuaisen lisääntynyttä kulutusta, voidaan tämän tutkimusten tulosten perusteella päätellä, että jäkäläryhmässä valkuaisaineiden synteesi- ja hajoamisnopeudet olivat yhtäsuuria ja rehuryhmässä valkuaisaineiden synteesi talvella oli suurempaa kuin niiden hajoaminen.
Kaikenkaikkiaan tuloksen osoittavat ettei poronvasojen kohtuullinen aliravitsemus talvella aiheuta lihasvalkuaisen käyttöä energiantuottoon ja vähentynyttä typen saatavuutta kompensoi hidastunut valkuaisaineiden hajoamien. Tulos tukee aikaisempia havaintoja poron hyvästä sopeutumisesta matalatyppiseen talviravintoon.

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Muscle protein metabolism in fed and undernourished reindeer calves during winter

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In freely grazing reindeer, protein metabolism during winter is limited by the low nitrogen content of lichens that is their main source of energy. The known adaptive changes that help to conserve nitrogen include the reduced excretion of urea in urine and the more efficient recycling of urea into the rumen, but practically nothing is known of the seasonal changes in the rates of protein synthesis and degradation which are the major determinants of protein mass. To compare effects of feeding and moderate under-nutrition on muscle protein metabolism, we measured muscle fibre area and the activity of cathepsin B, one of the key enzymes in protein degradation in reindeer calves fed either pelleted reindeer feed *ad libitum* (n=8) or restricted amounts of lichens (n=8). The calves were from the experimental herd of the Reindeer Herders Association at Kaamanen. The metabolisable energy in the lichen was 10.2 MJ/kg dry matter and that in the commercial feed 10.8 MJ/kg. Crude protein and crude fat contents on a dry-matter basis were 2.6 and 2.5%, and 10.2 and 3.9% in lichens and commercial feed, respectively. For 5 weeks starting from the end of January lichens were offered *ad libitum* and the amount of lichens consumed was recorded. During the following 2 weeks the amount of lichens was reduced to 60% of the *ad libitum* amount, and this restricted feeding was continued for an additional 6 weeks. Biopsy samples from the middle gluteal muscle were taken in November, January and at the end of the experiment in April.
The activity of cathepsin B decreased in all calves from November to January and remained at that low level for the rest of the study period. There were no differences between the two groups of calves. This result indicates that the rate of protein degradation is attenuated during winter irrespective of the type of feed or the amount fed. In all calves the muscle fibre composition remained unchanged during the winter. In the lichen group, the fibre size also remained unchanged, whereas in the calves fed pelleted feed the cross sectional area of type I and type IIA muscle fibres increased significantly from November to April. In an earlier study it has been suggested that the decrease in the cross-sectional area of muscle fibres indicates increased utilisation of muscle protein, and thus the present results can be taken as an indication that in the lichen group the rates of protein synthesis and protein degradation were in balance during the winter, but in the pellet-fed group the rate of protein synthesis was greater than that of protein degradation and the muscle fibres continued to grow also during the winter. In summary these results show that moderate under-nutrition causes no muscle wasting in reindeer calves, and the decreased availability of nitrogen is partially compensated for by adaptive decrease in protein degradation.

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Norwegian Reindeer Husbandry: administration and management

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The Norwegian Reindeer Husbandry Administration (NRHA) is the governmental institution responsible for the implementation of the Reindeer Husbandry Agreement and for the management of the natural resource upon which reindeer husbandry depends. The NRHA also serves as the secretariat for a variety of boards, councils and funds related to reindeer husbandry.
Reindeer are herded over an area of approximately 140.000 km^2 equivalent to about 40% of the mainland area of Norway. Northern and central Norway is divided into reindeer pasture areas which, in turn, are divided into 90 reindeer pasture districts. These areas account for >95% of all reindeer husbandry in Norway. Only Saami people may herd reindeer here. Reindeer herding is also carried out by both Saami and Norwegians in southern Norway in special 'Concession Areas' outside the main Reindeer Pasture Areas.
Reindeer pasture districts are divided into herding units consisting of one or more reindeer owners. Today there are 562 herding units that fully or in part employs about 2800 people.
There are today approximately 170.000 semi-domesticated reindeer in Norway, most of these (c. 120.000 animals) in the north of the country. The number of animals in the north has decreased by approximately 40% during the last 10 years. Elsewhere the number of animals has remained roughly constant.
Approximately 1500 ton of reindeer meat were produced in 1999/00 at a value of USD 7.3 mill. The rate of production varies considerable between different areas, from 2.1 to 16.8 kg / animal in the herd, reflecting different herding patterns, different rates of loss, variation in stocking density and other natural and anthropogenic constraints.
Loss of animals has a major influence on the rate of production and on herders' incomes. Animals are lost to predators, starvation and through accidents. Depredation accounts for 67% of the total annual loss of calves.
NRHA routinely collects a large amount of information on live body mass, carcass mass, birth rates, loss and pasture conditions. The total area of mountain, tundra and island pasture available for reindeer in Norway has decreased considerably during the last 100 years.
Issues of high importance are (i) the protection of pasture areas from development and other forms of human activity and (ii) the maintenance of a predictable and sustainable reindeer herding through the minimisation of losses and the maximisation of income.

Tidmässiga trender för ^{137}Cs halter i skogssvampar - inverkan på renar efter en kärnkraftverksolycka

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Trots att ^{137}Cs nedfallet från Tjernobyl 1986 var lågt, bara 1000 Bq/m^2 i finska Lappland, finns ännu mätbara halter i naturen och radiocesiummärkningen orsakad av olyckan har gjort det möjligt att studera transporten av cesium i näringskedjor och bestämma biologiska halveringstider. Rapporten presenterar resultaten av en undersökning om ^{137}Cs-konsentrationer i mykorrhiza svampar insamlade 1989 - 2000 från fyra olika skogsbeståndstyper i Kivalo forskningsområde nära Rovaniemi. Markvegetation- och ytjordprov insamlades 1993 och 1999. Cesiumhalterna förblir höga en lång tid i svampar och jord. Omkring 71-76 % av den totala ^{137}Cs koncentrationen i svampprov från 1989, liksom 40-50 % i markvegetationen och 50-60 % i de organiska ytjordskikten från 1993 härstammade ännu från den globala nedfall perioden. Beräkningarna är baserade på $^{137}Cs/^{134}Cs$ isotopförhållanden 2:1 eller 1,6:1 i Tjernobylnedfallet. Den höga andelen av det globala nedfallscesiumet i svamparna var också uppenbar när halterna i prov som insamlats 1989 jämfördes med svampprov från samma skogsbestånd 1983. Halterna låg nästan på samma nivå för all svamparter. Under den 12 år långa uppföljningsperioden har ^{137}Cs koncentrationerna i riskor (*Lactarius*), kremlor (*Russula*), soppar (*Suillus, Leccinum*) och rynkad tofsskivling (*Rozites caperata*) minskat långsamt med en biologisk halveringstid av 7-10 eller 18 år. För rödbandad spindelskivling (*Cortinarius armillatus*) var den biologiska halveringstiden lika lång som ^{137}Cs isotopens fysikaliska halveringstid, 30 år. Eftersom radioaktivt cesium ackumuleras effektivt i svampar och nedsöndringstiden är lång, har svamparna en stor och långvarig betydelse för renens ^{137}Cs intag efter en kärnkraftsolycka. Svamparnas inverkan har varit synlig i renar och i andra djur med stor intag av svamp efter goda svamphöstar i de områden i Norge och Sverige där Tjernobyl nedfallet var rikligt.

Time trends of Cs-137 in wild mushrooms - influence on reindeer after a nuclear accident

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Although the Chernobyl ^{137}Cs fallout in 1986 was low in Finnish Lapland, averaging only 1000 Bq/m^2, measurable concentrations are still found in nature. The sharp, additional radiocaesium labelling due to the accident has made it possible to follow the transport of caesium in foodchains, and to determine biological half-lives. This paper presents the results of a study on ^{137}Cs concentrations in the fruiting bodies of mycorrhizal mushrooms collected during 1989 - 2000 in four forest stands of different site types at the Kivalo research area near Rovaniemi. Surface vegetation and soil samples were also taken in 1993 and 1999. Radiocaesium was found to have a long retention time in the mushrooms and in the soil. In 1989, about 71-76 % of the total ^{137}Cs in the mushrooms originated from the global fallout period. In 1993, 40-50 % of the total caesium in surface vegetation, and 50 - 60 % in the organic soil layer, was derived from global fallout. The calculations are based on Chernobyl fallout $^{137}Cs/^{134}Cs$ isotope ratios of 2:1 or 1.6:1, respectively. The high proportion of global fallout caesium in the mushrooms was also evident when the mushroom concentrations in 1989 were compared to the reference samples from the same stands in 1983. The levels were almost the same in most of the species. During the 12-year follow-up period the ^{137}Cs concentrations of *Lactarius, Russula, Suillus, Leccinum* and *Rozites* species decreased slowly, with a 7 to 10 or 18-year-long biological half-life. For *Cortinarius armillatus*, the biological half-life appears to be of the order of the physical half-life of ^{137}Cs, 30 y. Because radiocaesium accumulates in mushrooms, and the rate of decrease is low, mushrooms will significantly contribute, for a long period of time, to the ^{137}Cs intake of reindeer following a severe nuclear accident. This phenomenon has clearly been visible, after good mushroom seasons, in reindeer and other animals that consume large amounts of mushrooms in those parts of Norway and Sweden most affected by the Chernobyl emissions.

Reproduksjonssuksess hos rein relatert til variasjon i klimafaktorer

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Betydningen av fenotypiske egenskaper og miljøfaktorer for reproduksjonssuksess hos tamreinsimler ble undersøkt i en flokk i Finnmark. Flokken besto av omkring 1500 dyr, hvor utvalgte simler undergikk nærmere undersøkelse. Flokken hadde sommerbeite på Magerøy og vinterbeite på Finnmarksvidda. Tilskuddsfôr ble brukt bare i tilfeller hvor dyras kondisjon var meget dårlig om våren.
I årene mellom 1992 og 1998 varierte drektighetsprosenten om vinteren fra 62,6 til 82,8% (gjennomsnitt: 76%) og andel simler med kalv ved foten om høsten varierte fra 61.5 til 80% (gjennomsnitt: 67.0%). Både drektighetsprosent og andel simler med kalv om høsten var signifikant relatert til alder i et kurvelineært mønster. Sannsynlighetene for drektighet og kalv om høsten var lave hos unge og eldre dyr og høye hos dyr i aldersgruppen 3-10 år. Drektighet ett år førte til redusert sannsynlighet for drektighet det påfølgende år dersom man i beregningene korrigerte for effekten av alder og år. For øvrig var pause i reproduksjonen mer vanlig hos unge enn hos eldre dyr. Høstvekten hos simlene var positivt relatert til sannsynligheten for drektighet. Selv om høstvekta varierte mellom år forklarte, den ikke all variasjonen i reproduksjonsuksess mellom år. Tapet av kalver før avvenning økte med synkende temperaturer i kalvingsområdet om våren og med økende snødybde på senvinteren. Fødselsåret for simler (cohort) hadde signifikant betydning for sannsynligheten for drektighet, men ikke for kalvenes overlevelse den første sommeren. Drektighetsprosenten for cohortene var signifikant korrelert med snødybden på senvinteren det året disse simlene var fostre.

Reproductive success of reindeer associated with climate variability

The relative importance of individual characteristics (phenotype) and extrinsic factors on annual and cohort variation in reproductive success was investigated in semi-domestic female reindeer (*Rangifer tarandus tarandus*) in Finnmark county, north Norway. The herd consisted of approximately 1500 free-living animals migrated between summer pasture on the island of Magerøy, and the winter pasture on the upland plateau of Finnmarksvidda. No supplementary feeding was used, except when the animals were in poor condition at the end of winter.
Between 1992 and 1998 the herd winter pregnancy rate ranged between 62.6% and 82.8% (mean=76.0) and the percentage of females with a calf at foot in the autumn ranged between 61.5 and 80 (mean = 67.0%). Both pregnancy and autumn calf at foot were significantly related to age in a curvilinear relationship, increasing from yearlings to prime-aged animals (3-10 years) and then declining again in old age. After controlling for age and annual effects, pregnancy in the previous year significantly reduced the probability of being pregnant again. Reproductive pauses were more common in young than in older females. Autumn body weight significantly influenced the probability of pregnancy but although body weight varied between years it did not account for all the annual variation in the probability of pregnancy and having a calf at foot. Calf losses before weaning increased with low spring temperatures at the coast and tended to increase with late winter snow depth. The year a female was born (cohort) significantly influenced the probability of pregnancy but not the probability of calf surviving until the autumn. Cohort pregnancy rates were correlated negatively with late winter snow depth when the female was *in utero*.

Tap og dødelighet hos rein i Finnmark - et forprosjekt

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NVH/IAV søkte sammen med Veterinærinstituttet, Planteforsk Holt og Samisk høgskole Norges forskningsråd i 2000 om et 5-årig strategisk forskningsprogram (SUP); "Tap, dødelighet og flokkhelse hos rein in Finnmark." SUP skulle omfatte undersøkelser rundt årsaker til tap, inkludert rovdyrskader, men også andre veterinærmedisinske og tverrfaglige aspekter av betydning for helse og produksjon i reindriften. Forprosjektet som beskrives her, skulle gi tendenser og være hypoteseregulerende for SUP, samt teste realismen i opplegg for innsamling av dyremateriale. Innsamling og journalføring av materiale ble gjennomført av reineierne i samarbeid med distriktsveterinærene, Statskog fjelltjeneste og reindriftsforvaltningen. Man skulle bestemme dødsårsaker på kadavre funnet på vinterbeite og i kalvingsområdene 2000 for to flokker i Karasjok og to i Kautokeino, og antyde betydningen av rovdyrangrep, ernæringstilstand, E-vitamin og selenstatus, parasittbelastning, virus - og bakteriesmitte og beitetilgjengelighet. Innsamling av materiale fungerte godt. Dyrematerialets representativitet var bergrenset, spesielt var rovdyrdrepte dyr sterkt underrepresentert. Fra vinterbeitene mottok prosjektet 32 kadavre, hvorav 28 hadde underernæring som dødsårsak. Det var likevel stor variasjon mellom flokkene. Mens én flokk hadde store tap, der 17 av 18 innsendte dyr var død av avmagring, hadde en annen flokk ikke tap pga sult/avmagring. De fleste avmagrede dyr var omkommet seint i beitesesongen. Mange var fôret med silo. Analyser av vominnhold tydet på at silofôrets kvalitet ikke var velegnet til rein. Sterke parasittinfeksjoner (hudbrems, svelgbrems og lungeorm) kunne hos enkelte dyr være en betydelig medvirkende årsak til avmagring og død. Prosjektet mottok 15 døde spekalver, hvorav tre var drept av rovdyr. De andre var små og svakfødte, og trolig omkommet av kulde, manglende kroppsreserver og/eller lite melk. Selen- eller E-vitaminmangel tyder ikke på å være årsak til tap. Dokumentasjon av vinterbeitets tilgjengelighet krever optimalisering av metodene. Herpesvirus, bovint virusdiarevirus og parapoxvirus (munnskurv), samt potensielt sykdomsfremkallende bakterier, utelukkes ikke å ha innvirkning på tap og dødelighet.

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Loss and mortality in reindeer in Finnmark County, Norway – a preliminary project

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In 2000, NVH/IAV applied together with VI, Holt Research Centre and Sámi College to the Norwegian Research Council for a long-term strategic research programme (SUP); "Loss, mortality and herd health in semi-domesticated reindeer in Finnmark County, Norway." The planned SUP included investigations on causes of reindeer loss, including predator injuries, but also other related aspects important for reindeer health and production. The purpose of the preliminary project reported here, was to point out tendencies and regulate some hypotheses for SUP, and look at the realism in collection of animal material. Dead reindeer were brought in to the project and registered by the participating reindeer herders in collaboration with the district veterinary officers, Statskog fjelltjeneste and the Reindeer Husbandry Administration. The causes of death, including predators, was to be determined of carcasses found on winter pasture and in the calving areas 2000 for two herds in Karasjok and Kautokeino, respectively. Furthermore, tendencies of nutritional condition, status of vitamin E and selenium, parasite burden, virus – and bacterial infections and access to the winter pasture plants were investigated. Animal material was successfully collected to the project, but its representativity was limited; reindeer killed by predators being strongly underrepresented. Twenty eight out of 32 dead reindeer from the winter pastures had died from starvation. Nevertheless, there was a large variation between the participating herds. Most of the starved reindeer had died late in the winter season. Many were given silage. Analyses of rumen contents indicated the silage not to be suitable for reindeer. Heavy parasite burden in some undernourished animals may well have contributed to death. Three out of 15 dead newborn calves were killed by predators. The other calves were weak and small, and had probably died due to cold weather and and/or starvation. The study indicated that selenium- and vitamin E-deficiency is not a problem, while herpes virus, bovine virusdiarrhea–virus, parapoxvirus, and potentially patogenic bacteria cannot be excluded as causes of reindeer loss and mortality.

The project was supported by the Norwegian Reindeer Husbandry Research Counеil.

Klinisk evaluering av nyetablerte optimale immobiliserings-doser av medetomidin-ketamin hos oppstallet rein (*Rangifer tarandus tarandus*)

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Formålet med studien var å evaluere kliniske effekter og repeterbarheten av kliniske effekter av nyetablerte optimale immobiliseringsdoser av medetomidin (MED)-ketamin (KET) hos oppstallet rein (*Rangifer tarandus tarandus*). Tolv friske 6- til 8-måneder gamle reinkalver ble inkludert in studien. Hver rein ble immobilisert én gang med en initial dose på 0.06 mg MED/kg kroppsvekt og 0.3 mg KET/kg, og to ganger med en nyetablert individuell optimal dose av MED-KET. Oppvåkning ble oppnådd ved å gi atipamezole i doser 5 ganger MED-dosen, 45 minutter etter administrasjon av MED-KET. Registrerte variable var tid til første tegn på sedasjon, tid til reinen løftet hodet opp, og tid til reinen stod. Oksygenmetning av arterielt hemoglobin (SpO_2), respirasjonsraten (RR), hjertefrekvens (HF), og rektaltemperatur (RT) ble registrert 10, 25 og 40 minutter etter immobilisering. Gjennomsnittlig tid til første tegn på sedasjon og tid til reinen løftet hodet opp var signifikant reduserte når dyrene ble gitt optimale doser, sammenlignet med den initiale dosen. Gjennomsnittlig SpO_2 forble > 90% under immobilisering med initialdosen, var signifikant lavere ved de optimale dosene men steg i løpet av immobiliseringsperioden fra 85 til 89%. Ved alle dosene økte RR signifikant gjennom hele registreringsperioden, men RT og HF var ganske konstante og sammenlignbare med tilsvarende verdier målt hos rein om vinteren. Med unntak av tid til reinen stod, var alle tidsvariable, SpO_2, RR, RT, og HF repeterbare. Immobilisering av oppstallet rein med de etablerte optimale doser er klinisk akseptabelt, likevel bør SpO_2 overvåkes nøye. De optimale dosene produserte de samme kliniske effekter under repetert immobilisering av samme dyret.

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Clinical evaluation of established optimal immobilizing doses of medetomidine-ketamine in captive reindeer (*Rangifer tarandus tarandus*)

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The objective was to evaluate clinical effects and repeatability of clinical effects of established optimal immobilizing doses of medetomidine (MED)-ketamine (KET) in reindeer (*Rangifer tarandus tarandus*). Twelve healthy 6- to 8-month old reindeer were included in the study. Each reindeer was immobilized once with an initial dose of 0.06 mg of MED/kg of body mass and 0.3 mg KET/kg and twice with an optimal dose of MED-KET. Reversal was achieved with 5 mg of atipamezole/mg of MED injected 45 minutes after MED-KET administration. Recorded variables included time to first sign of sedation, time until the animal lifted its head up, and time until the reindeer stood. Oxygen saturation of arterial hemoglobin (SpO_2), respiratory rate (RR), heart rate (HR), and rectal temperature (RT) were recorded 10, 25, and 40 minutes after immobilization. Mean time to first sign of sedation and time until an animal lifted its head up were significantly reduced for reindeer given optimal doses, compared with the initial dose. Mean SpO_2 remained > 90% during initial immobilization, was significantly lower for the optimal doses, but increased during immobilization from 85 to 89%. At all doses, RR increased significantly throughout the recorded period; however, RT and HR were rather constant and were similar to corresponding values recorded in reindeer in winter. Except for time until reindeer stood, all time variables, SpO_2, RR, RT, and HR were repeatable. Immobilization of captive reindeer with the established optimal doses is clinically acceptable, although SpO_2 should be carefully monitored. Optimal doses produced the same clinical effect during repeated immobilization of the same reindeer.

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Korttids tap i kroppsmasse hos rein

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Levendevekt (LBM) er ofte brukt for å illustrere vekst, velferd og produksjonspotensial hos dyr. Nøyaktige målinger av LBM krever både en nøyaktig kalibrert vekt og en oppfattelse av dyrets dynamiske variasjon i kroppsmasse som skjer sesongmessig, fra dag til dag og til og med fra time til time. I et feltforsøk ble 96 melkesimler (≥ 2år) plukket ut fra en tamreinflokk på ca 3000 dyr. Disse ble samlet, flere hundre om gangen i reingjerdet, som en del av normal drift. Hvert dyr ble veid to ganger samme dag, til nærmeste 0,2 kg på en elektronisk vekt, med 2 til 8 timer mellom hver veiing. Ingen av dyrene hadde tilgang til mat eller vann mens det var i innhegningen. I et laboratorieforsøk, ble seks reinokser (17 mnd) holdt innendørs (11°C) i separate metabolismekamre for 12 timer uten tilgang til mat eller vann. Dyrene ble veid til nærmeste 0,5 kg hver andre time på en elektronisk vekt. All urin og faeces som ble produsert, ble separert ved innsamling og veid, til nærmeste gram, hver time. All rein i feltforsøket tapte vekt mellom veiingene. Gjennomsnittlig tapsrate var 535 g· h^{-1} (7.3 g· kg LBM^{-1}· h^{-1}). Alle reinoksene tapte vekt over det 12 timer lange laboratorieforsøket. Vekttapsraten var 308 g· h^{-1} (6.0 g· kg LBM^{-1}· h^{-1}). Produksjonsraten av urin og faeces forklarte 56% (*s* 13,1) av det observerte tapet i LBM. Det var en liten, men signifikant, forskjell i raten av vekttap mellom felt- og laboratorieforsøket. Rein i felt tapte vekt raskere enn rein i metabolismekamrene (P<0,001). Rein holdt i innhegning uten tilgang til mat eller vann taper vekt signifikant i løpet av en arbeidsdag. Vekttapsraten er tilnærmet linear fra 2 timer. Tapet av vekt skyldes i stor grad kontinuerlig produksjon av urin og faeces. For å veie dyr nøyaktig er det nødvendig å standardisere tiden som har forløpt siden dyrenes siste måltid.

Short-term loss in body mass in reindeer

Live body mass (LBM) is widely used to assess the growth, welfare and productive potential of animals. Accurate measurement of LBM requires both a carefully calibrated balance and an appreciation of the dynamic variation in the body mass of the animals that occurs between seasons, from day to day and even from hour to hour. In a field trial, 96 lactating adult (≥ 2 yr.) female semi-domesticated reindeer were selected from a herd of approximately 3000 animals which had been gathered, several hundred at a time, in an outdoors paddock as part of normal management procedure. Each animal was weighed to 0.2 kg on an electronic balance twice on the same day with an interval of between 2 and 8 h between successive weighings; none had access to food or water while it was in the paddock. In a laboratory trial, six male reindeer (17 mo.) were held indoors (11°C) in individual metabolism chambers for 12 h without access to food or water. The animals were weighed to 0.5 kg every 2 h on an electronic balance. All the urine and faeces that each produced was separated at collection and weighed hourly to 1 *g*. All adult reindeer lost weight between successive weighings in the field trial. The mean rate of weight loss was 535 g· h^{-1} (7.3 g· kg LBM^{-1}· h^{-1}). All yearling reindeer lost weight over 12 h in the laboratory trial. The rate of weight loss was 308 g· h^{-1} (6.0 g· kg LBM^{-1}· h^{-1}). The rate of production of urine and faeces was effectively linear over the first 8 *h* in the laboratory trial. Production of urine and faeces explained on average 56% (*s* 13.1) of the observed drop in LBM. There was a small but significant difference in the rate of weight loss between the field and the laboratory trials; reindeer in the field lost weight more rapidly compared to animals in the metabolism chambers (P<0.001). Reindeer maintained in a paddock without access to water and food lose significant amounts of weight during the course of one working day. The rate of weight loss is effectively linear from 2 h. The loss of weight is due in large part to the continuous production of urine and faeces. To weigh animals accurately it is necessary to standardise the length of time elapsed since they last fed.

Interaktioner mellan ren, människa och topografi

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Den spatiala fördelningen av ren (*Rangifer tarandus tarandus*) och lav (*Cladina* spp.) har undersökts genom spillningsinventering och mätning av lavhöjden. Detta har gjorts för att utvärdera vegetationsslitaget på Långfjället (Lat 62°10', Long 12°20') i norra Dalarna, som är ett område i Idre Nya Sameby. Det har varit oklart i vilken grad slitaget beror på normalt strövande från renarnas sida och mänskliga störningar som driver renarna över fjället. Förekomst av spillning relaterades därför till höjd, vegetationstyp och vandringsleder. Lavhöjden, som användes som en indikator på slitaget, relaterades till spillningshögar, vandringsleder, höjd och vegetationstyp. Täthetsfördelningen av spillning och lav visualiserades också genom interpolation i ett GIS-program. Det visade sig att spillningstätheten var högre på hög höjd, men att det inte var någon större skillnad i täthet mellan vegetationstyper. Att renen inte visade preferens för någon speciell vegetationstyp kan ha att göra med att området var väldigt homogent. Eftersom vindhastigheten ofta är starkare högre upp kan den högre spillningsförekomsten på höjder antagligen kopplas till att renen vill undkomma insekter och finna svalka under varma sommardagar. Spillningsförekomsten tenderade också att bli större nära vandringslederna vilka ofta följde höjdsträckningarna i terrängen. Lavhöjden visade inget generellt mönster med avseende på spillning och vandringsleder. Den var lägre på hög höjd, men inte nödvändigtvis där det var mycket renspillning, även om det mönstret förekom i några vegetationstyper. I den norra mer oåtkomliga delen av området syntes däremot ett tydligt mönster, där var lavhöjden hög (10-20 cm) och spillningsförekomsten låg. I närheten av vandringslederna var lavhöjden dock lägre (1-2 cm) i vegetationstypen torr lavdominerad rished, vilket kan vara orsakat av slitage av både turister och renar. I ett område som är homogent, lite kuperat och lättåtkomligt som Långfjället, använde renarna hela området i så pass hög grad att mer tydliga spatiala mönster suddades ut. Man kan förvänta sig att ett mer alpint område skulle ha kunnat uppvisa en mer differentierad användning.

Interactions between reindeer, humans and topography

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Spatial pattern of reindeer (*Rangifer tarandus tarandus*) and lichen (*Cladina* spp.) was investigated by counting pellet-groups, and recording lichen height. This was done in order to evaluate the wear of the vegetation at a southern Swedish mountain, Långfjället (Lat 62°10', Long 12°20'). Normal movement of reindeer in the area and/or activities by human that have increased the movement of the reindeer might have caused the wear. The reindeer pellets were therefore related to altitude, vegetation type, and tourist trails. The lichen height, which was used as an indicator of the wear, was investigated in relation to reindeer pellets, tourist trails, altitude and vegetation type. The spatial pattern of the pellet-groups and the lichen was also visualized through interpolation of the data in a GIS-programme. 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 high density of pellets on summits, and especially on south slopes, may have been a result of reindeer seeking relief from insect harassment and to thermoregulate where the wind velocity is higher. The pellet-group density also tended to be higher near the tourist trails, which tended to follow higher altitudes in the terrain. The lichen height had no general pattern in the area on a whole in relation to reindeer pellets or tourist trails. Thus, in the northern more unreachable part of the area a clear pattern was seen were the lichen height was high (10-20 cm) and the pellet-group density was low. The lichen height was shown to be lower (1-2 cm) in habitats of high altitudes, but not necessarily in habitats with much reindeer pellets, though this occurred in some vegetation types. Near the tourist trails the lichen height decreased in the vegetation type dry heath with lichens, which can be a result of both reindeer and tourists wear of the lichen layer. In an area like Långfjället, which is homogeneous and quite flat and easily reached by the reindeer, the clear spatial pattern of the reindeer might have been erased. However, in a more alpine area with higher summits it could be expected that the habitat use of the reindeer would be more differentiated.

Poron kunto ja eri kudosrasvojen rasvahappokoostumus

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Tässä tutkimuksessa kartoitettiin poron eri kudosrasvojen rasvahappokoostumusta ja arvioitiin rasvahappokoostumuksen merkitystä ravitsemustilan indikaattorina (Soppela 2001). Tutkimuksen osatöissä selvitettiin (1) vastasyntyneiden poronvasojen seerumin rasvahappokoostumusta ja niiden emien seerumin ja maidon rasvahappokoostumusta, (2) rasvakudosten ja (3) luuydinrasvojen rasvahappokoostumusta hyväkuntoisilla poroilla syksyllä ja aliravituilla poroilla talvella ja keväällä; sekä (4) seerumin rasvahappokoostumuksen muutoksia hyväkuntoisilla ja lievästi aliravituilla poronvasoilla talvella ja keväällä. Tutkimukset tehtiin Paliskuntain yhdistyksen Kaamasen koeporotokassa sekä Muddusjärven ja Poikajärven paliskunnissa. Porojen kuntoa arvioitiin elo- ja teuraspainojen sekä verianalyysien avulla. Kudosrasvojen rasva-aineista tehtiin kaasukromatografiset rasvahappoanalyysit.

Vastasyntyneillä poronvasoilla oli hyvin alhaiset tärkeiden monityydyttymättömien rasvahappojen eli linolihapon ja α-linoleenihapon tasot seerumissa verrattuna niiden emien seerumiin. Näitä välttämättömiä rasvahappoja oli niukasti myös emän maidossa, mutta niiden osuudet lisääntyivät vasojen seerumissa merkitsevästi ensimmäisten vuorokausien aikana. Hyväkuntoisten porojen rasvakudokset sisälsivät pääasiassa tyydyttyneitä eläinrasvoja kuten palmitiinihappoa ja steariinihappoa sekä tyydyttymätöntä öljyhappoa. Rasvakudosten rasvahappokoostumus vaihteli vain vähän kudoksen sijaintipaikan suhteen ja siinä tapahtui talvella porojen kunnon heikentyessä vain vähäisiä muutoksia. Reisiluun ytimen rasvahappokoostumus muistutti hyväkuntoisilla poroilla rasvakudosten rasvahappokoostumusta ja sisälsi paljon palmitiini- ja steariinihappoa. Jalkapöydän luuytimessä suurin osa rasvahapoista oli öljyhappoa (46-57%), jonka sulamispiste on alhainen. Porojen kunnon heikentyessä öljyhapon ja monityydyttymättömien rasvahappojen suhteelliset osuudet luuydinrasvoissa vähenivät. Hyväkuntoisten poronvasojen seerumissa oli vielä keskitalvesta runsaasti linoli- ja α-linoleenihappoa. Jäkäläruokinnalla vasojen painot putosivat ja seerumin rasva-aineiden ja monityydyttymättömien osuudet laskivat nopeasti alhaiselle tasolle. Valkuaispitoisella pororehulla ruokituilla vasoilla tapahtui seerumin rasvahapoissa samanlaisia, mutta hitaampia ja pienempiä muutoksia. Niiden kasvu käynnistyi keväällä noin kaksi kuukautta aiemmin kuin jäkäläryhmän vasoilla.

Tulokset osoittavat, että poron kunnossa tapahtuvat muutokset heijastuvat selvästi veren ja luuydinrasvojen rasvahappokoostumuksessa, mutta eivät vaikuta paljoakaan rasvakudosten rasvahappokoostumukseen. Vastasyntyneillä poronvasoilla on vajausta välttämättömistä monityydyttymättömistä rasvahapoista. Porot saavat näitä rasvahappoja talvella vähän luontaisesta ravinnostaan, etenkin jäkälistä. Tulokset viittaavat siihen, että porojen ruokinnassa olisi tarpeen kiinnittää valkuaisen lisäksi huomiota rasvojen laatuun. Jos rehussa on paljon valkuaista, vasojen kasvu käynnistyy aikaisemmin keväällä ja tällöin myös kasvulle välttämättömien monityydyttymättömien rasvahappojen tarve ravinnosta kasvaa. Poron rasvojen jatkotutkimuksissa olisi tarpeen selvittää keinoruokinnan vaikutusta poronlihan rasvahappokoostumukseen, koska se voi vaikuttaa lihan makuun ja laatuun.

Soppela, P. 2001. Poron kunto, eri kudosrasvojen rasvahappokoostumus ja ruhon rasvojen laatu. (Body Condition, the Fatty Acid Composition of Different Tissue Fats and Carcass Fat Quality, English summary) Arktisen keskuksen tiedotteita 34: 1-35.

The fatty acid composition of different tissue fats in reindeer as related to nutritional condition

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This study reports the fatty acid composition of different tissue fats in reindeer as related to nutritional condition (Soppela, 2001). The subprojects deal with (1) the fatty acid composition of serum lipids in the newborn reindeer, and the fatty acid composition of their mother's serum and milk; (2) the fatty acid composition of adipose tissues and (3) of bone marrow fats in reindeer in good condition in autumn and in undernourished reindeer in winter and spring; and (4) the fatty acid composition of serum lipids in well-fed or moderately undernourished reindeer calves during winter and spring. The reindeer were mainly from the experimental herd of the Finnish Reindeer Herders' Association, located in Kaamanen in Finnish Lapland and from Poikajärvi and Muddusjärvi reindeer herding co-operatives. Nutritional condition of reindeer was evaluated by body and carcass weights and blood analyses. The fatty acid composition of major lipids of the tissue fats was analysed by gas liquid chromatography.

Newborn reindeer had very low proportions of the principal polyunsaturated fatty acids (PUFAs), or linoleic and α-linolenic acids in their serum lipids as compared to their mothers' serum. These essential fatty acids were also present in small amounts in the mother's milk but their proportions rapidly increased in the serum of the calves during the first few days after birth. The adipose tissues of reindeer in good condition were dominated by saturated fatty acids such as the palmitic and stearic acids, and by unsaturated oleic acid. The fatty acid composition of adipose tissues varied only slightly between different locations, and there were only minor differences between reindeer in good condition in autumn and in poor condition in spring. The fatty acid composition of femur bone marrow of reindeer in good condition was similar to that of adipose tissues. The dominant fatty acid in metatarsal bone marrow was oleic acid (46-57%) that has a low melting temperature. The proportions of oleic acid and the principal PUFAs were decreased in the bone marrow of undernourished reindeer. Reindeer calves in good condition had high proportions of linoleic and α-linolenic in their serum still in mid-winter. When the calves were fed lichen, their body weights dropped and their serum lipids and proportions of the principal PUFAs decreased to a very low level. The calves fed a high protein feed had similar but slower and smalles changes in their serum values than the lichen group. The growth of the feed group started two months earlier in spring than it did in the lichen group.

The results show that changes in the nutritional condition of reindeer are clearly reflected in the fatty acid composition of blood and bone marrow lipids but only slightly in the fatty acid composition of adipose tissues. Newborn reindeer have a poor status of essential PUFAs. Reindeer get PUFAs poorly from their nutrition during winter, especially from lichens. The results suggest that when feeding reindeer, it would be important to pay attention also to quality of fat in feeds, in addition to their protein content. If feed contains a lot of protein, the growth of reindeer starts earlier in spring and dietary requirements of the essential PUFAs are increased. In further studies, it would be important to study the effects of artificial feeding on the fatty acid composition of reindeer meat, as this may affect on taste and quality of meat.

Soppela, P. 2001. Poron kunto, eri kudosrasvojen rasvahappokoostumus ja ruhon rasvojen laatu. (Body Condition, the Fatty Acid Composition of Different Tissue Fats and Carcass Fat Quality, English summary) Arctic Centre Reports 34: 1-35.

Magnesiumia sisältävät pötsibolukset poron Mg-lisänä

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Tässä tutkimuksessa selvitettiin magnesiumia (Mg) sisältävien pötsibolusten vaikutusta poron (*Rangifer tarandus tarandus*) magnesiumlisänä. Aiemmissa märehtijöillä tehdyissä tutkimuksissa on havaittu, että veren magnesiumin ja kalsiumin (Ca) pitoisuudet ovat vuorovaikutuksessa keskenään. Tästä syystä kiinnostuksen kohteena oli myös magnesiumlisän vaikutus veren Ca-pitoisuuteen.
Kaksi magnesiumia sisältävää pötsibolusta, joista kukin sisältää noin 15 g Mg, laitettiin kuuden 9 kk ikäisen poronvasan pötsiin 18 vrk:n jäkäläruokinnan jälkeen. Jäkäläruokintaa jatkettiin 17 vrk pötsibolusten laittamisesta, minkä jälkeen vasoja ruokittiin vielä 10 vrk:n ajan teollisella poronrehulla. Kokeen aikana vasat olivat kukin omassa häkissään. Vettä tarjottiin ad libitum. Kaulalaskimosta otetuista verinäytteistä määritettiin plasman Mg- ja Ca-pitoisuus. Lisäksi eläimistä kerättiin virtsanäytteitä, joista analysoitiin molempien kivennäisaineitten pitoisuus suhteutettuna virtsan kreatiniiniin (Mg/C ja Ca/C, mmol/mmol). Pötsibolusten sulamista pötsissä seurattiin punnitsemalla bolukset viikoittain. Tämä oli mahdollista poistamalla bolukset pötsistä vasojen vasempaan kylkeen operoidun pötsiavanteen kautta. Samalla mitattiin myös pötsin sisällön pH.
Pötsibolukset nostivat plasman Mg-pitoisuutta. Huippupitoisuus plasmassa (keskiarvo 1.13 mmol/l, S.D. 0.04) saavutettiin 2-6 vrk:n sisällä bolusten laittamisesta, ja se oli merkitsevästi korkeampi ($p<0.01$) kuin plasman Mg-pitoisuus juuri ennen bolusten laittamista pötsiin (0.82±0.16 mmol/l)). Tämän jälkeen plasman Mg-pitoisuus alkoi laskea, mutta pysyi silti lähtötason (0.91±0.11 mmol) yläpuolella. Plasman Ca-pitoisuus laski pötsibolusten laittamisen jälkeen, ja oli alimmillaan (2.39±0.03 mmol/l) 1-5 vrk:n kuluttua bolusten laittamisesta pötsiin. Minimipitoisuus oli merkitsevästi pienempi kuin plasman Ca-pitoisuus juuri ennen bolusten laittamista ($p<0.01$). Tämän jälkeen plasman Ca-pitoisuus nousi asteittain ja oli takaisin lähtötasolla (2.44±0.15 mmol/l) kokeen loppuun mennessä.
Pötsibolusten laittamisen jälkeen sekä Mg:n että Ca:n erittyminen virtsaan lisääntyi. Ero virtsan Ca/C suhteen välillä juuri ennen bolusten laittamista (0.95±0.32 mmol/mmol) ja maksimin aikana (2.10±0.36, 10-21 vrk:tta bolusten laittamisesta) oli merkitsevä ($p<0.001$). Virtsan suurimman Ca/C suhteen sijoittuminen ajallisesti plasman Ca-pitoisuuden minimin jälkeen viittaa siihen, että virtsan Ca-erityksen kasvu magnesiumlisän antamisen jälkeen saattaa olla sekundäärinen vaste, ja muut fysiologiset säätelymekanismit vaikuttavat lisäksi plasman Ca-pitoisuuden laskuun.
Pötsibolusten sulamisen suuri vaihtelu vasojen välillä (50-80%), mihin tulosten perusteella vaikuttaa mm. pötsin sisällön pH, viittaa siihen, että pötsibolusten muodossa olevan Mg-lisän vaikutusaika voi olla vaikeasti ennakoitavissa etenkin luonnonolosuhteissa.

Magnesium alloy rumen boluses as Mg–supplement for reindeer

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Mineral imbalances may occur among reindeer as a result of low mineral content of winter forage, especially when combined with restricted feed intake. In this study, magnesium (Mg) alloy rumen boluses were used as Mg -supplement for reindeer. Findings from other ruminants have indicated an interrelationship between plasma Mg and calcium (Ca). Thus, one aim was to study if the Mg supplement had an effect on plasma Ca concentration.

Two Mg alloy rumen boluses, each containing approximately 15 g of Mg, were inserted to the rumen of six nine-month-old female reindeer calves (*Rangifer tarandus tarandus*) after 18 days of lichen feeding. Lichen feeding continued for 17 days after insertion of the boluses, and was followed by feeding with Mg rich pelleted concentrates for 10 days. The animals were housed indoors in separate cages and fed individually. Blood samples were collected for measurements of plasma Mg and Ca. In addition, analyses included urine concentrations of the two minerals in proportion to urine creatinine concentration (Mg/C and Ca/C). The decomposition of the boluses in the rumen was followed by weighing them once a week simultaneously with measurements of rumen content pH. This was possible by removing the boluses through rumen cannulae, that had been operated on the caudal left side of the animals.

The rumen boluses increased plasma Mg concentration. The peak plasma Mg concentration (mean 1.13 mmol/l, S.D. 0.04) was achieved 2-6 days after insertion of the boluses, and was significantly higher ($p<0.01$) than the plasma Mg concentration prior to insertion (mean 0.82 mmol/l, S.D. 0.16). Thereafter, plasma Mg concentration gradually decreased but remained above the mean plasma level of 0.91 ± 0.11 mmol/l at start. Plasma Ca concentration decreased with increasing plasma Mg level. The minimum plasma Ca level (mean 2.39 mmol/l, S.D. 0.03) was reached 1-5 days after insertion of the boluses. Thereafter, it increased gradually, and was back at the level at start (mean 2.44 mmol/l, S.D. 0.15) by the end of the study. The decrease in plasma Ca between the level prior to insertion of the boluses and at the concentration minimum was significant ($p<0.01$).

There was a tendency towards increasing excretion of both Mg and Ca after the rumen Mg boluses were inserted. The difference between the urine Ca/C ratios before insertion of the boluses (0.95 ± 0.32 mmol/mmol) and the peak ratio (2.10 ± 0.36 mmol/mmol), that occurred 10-21 days after insertion of the boluses, was significant ($p<0.001$). The fact that peak urine Ca/C ratios occurred after plasma Ca minimum suggests, that the increase in urinary Ca excretion may be a secondary response, and other mechanisms may have been primary factors behind the plasma Ca lowering effect of Mg supplement.

Further studies are needed to study the prevalence of Mg related mineral disturbances among reindeer before using Mg supplements in reindeer management. The large variation in decomposition of the rumen boluses between animals (50-80 %) that was possibly related to rumen content pH and diet indicates, that timing and duration of Mg supplementation provided by this method may be unpredictable in field conditions.

Patologiske funn hos rein som har dødd av underernæring

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Vi presenterer her typiske patologiske funn hos rein som var død som følge av underernæring i tre flokker i Finnmark vinteren 2000. Undersøkelsene var en del av forprosjektet "Tap og dødelighet hos rein i Finnmark" (se egen poster). Forprosjektet mottok 32 frosne reinkadavre fra flokkene Kautokeino 1 (n=18), Kautokeino 2 (n=5) og Karasjok 1 (n=9). De døde dyrene var omkommet (n=30) eller avlivet (n=2) i perioden 3. mars til 24. mai. Mange var tilbudt silo som tilleggsfór på beite fra februar-mars, og en del kalver var tatt hjem for kriseforing med silo og pellets. Lav ble gitt ved overgangsfóring. Botaniske analyser av vominnhold (NINA, Trondheim) tydet imidlertid på at silofóret har vært mindre egnet for fóring av rein (mye stengler og lite blad). Kadavrene ble obdusert etter en standardisert prosedyre som inkluderte rutinemessige bakteriologiske, histologiske og parasittologiske undersøkelser. Kadaverets ernæringsstatus ble bedømt ut fra synlig fett på kadaveret (underhud, bukhule, hjerte, beinmarg). I tillegg ble fettinnhold i beinmarg fra lårbein bestemt ved kjemisk analyse (Unilab Analyse AS, Tromsø). For 28 av de 32 undersøkte kadavrene var hovedfunnet ved obduksjon sterk avmagring. De øvrige fire var død/avlivet som følge av rovdyrskader eller andre skader. Ett av de rovdyrskadde dyrene var også sterkt avmagret. Aldersfordelingen blant de avmagrete dyrene var: Kalver (9-12 mnd): n=18, åringer (21-24 mnd): n=4, voksne (> 2år): n=7. Tolv av kalvene var oksekalver og 6 simlekalver, mens alle åringer og voksne var simler. Gjennomsnittlig rund vekt hos de avmagrete dyrene var: Voksne simler: 41,9 kg (min-max: 37-48,5 kg), årittger: 37,9 kg (min-max: 24,5-51 kg), simlekalver: 22,7 kg (min-max: 18-26 kg), oksekalver: 25,7 kg (min-max: 19-31,5 kg). Kadavrene manglet synlig fettvev på kroppen og rundt organer. Øynene var innsunkne. På hjertet og i beinmarg var det normale fettvevet erstattet av en rødlig vandig eller geleaktig masse (serøs fettvevsatrofi). Kjemiske analyser viste <2% fett i beinmarg. Muskulaturen, spesielt over rygg og kryss, var uttalt atrofisk. Leveren var mørk, nesten svart, og det var opphopning av pigmentet hemosiderin i levermakrofager. Det ble bare funnet løs avføring hos 2 dyr, begge kalver som var fóret med silo og reinpellets. Det ble ved obduksjonene ikke funnet tegn til sjukdom som kunne forklare avmagringen, og vi konkluderer derfor med at den primært skyldes underernæring. Parasittologiske undersøkelser viste at høy parasittbelastning kan ha bidratt til avmagring hos enkeltdyr. De viktigste parasittene i denne sammenheng ble vurdert å være larver av hudbrems og svelgbrems, samt lungeorm (se også egen poster).

Reindriftens Fagråd takkes for økonomisk støtte til prosjektet.

Pathological findings in reindeer succumbed to starvation

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We here present the major pathological findings in reindeer that had succumbed to starvation during the winter 2000. The carcasses were collected from three herds in Finnmark county, Norway. The study was part of the pilot project "Loss and mortality in reindeer in Finnmark" (see separate poster). The project received 32 frozen reindeer carcasses from the herds Kautokeino 1 (n=18), Kautokeino 2 (n=5), and Karasjok 1 (n=9). The dead animals were succumbed (n=30) or euthanised (n=2) in the period from the 3rd of March to the 24th of May.
Many of the animals had been offered grass ensilage as supplemental feeding on winter pasture from February/March, and some of the calves had been taken home for emergency feeding with lichen, ensilage and pellets. However, botanical analyses of rumen content (NINA, Trondheim) suggested that the ensilage used had a non-optimal quality as feed for reindeer (too much stem and too little leaves). Necropsies were performed according to a standard operating procedure, and tissue samples were collected for bacteriological, histological and parasitological analyses. The nutritional status of the carcasses was judged by visual examination of body fat (in subcutis, abdomen, pericardium and bone marrow). The fat content in bone marrow from femur was also measured chemically (Unilab Analyse AS, Tromsø). In 28 of the 32 carcasses examined the major finding was severe emaciation (cachexia). The other four animals had died/been euthanised because of injuries caused by predators or other trauma. One of the animals injured by predators was also cachectic. The age distribution of cachectic animals was as follows: Calves (9-12 mo): n=18, yearlings (21-24 mo): n=4, adults (>2 years): n=7. There were 12 male and 6 female calves, whereas all yearlings and adults were females. The average carcass weights of cachectic animals were: Adults: 41,9 kg (min-max: 37-48,5 kg), yearlings 37,8 kg (min-max: 24,5-51 kg), female calves: 22,7 kg (min-max: 18-26 kg), and male calves: 25,7 kg (min-max: 19-31,5 kg). The necropsies revealed the following typical changes: The eyes were sunken, and there were no visible fat in subcutis or around organs. Muscle mass were markedly reduced and the animals revealed a serous atrophy of pericardial fat and bone marrow. Chemical analyses showed < 2% fat in bone marrow. The liver appeared dark, almost black in colour, and there were excessive deposits of hemosiderin in liver macrophages. Soft faeces was observed in only two carcasses, both were calves which had been fed ensilage and pellets. As the necropsies revealed no signs of illness that could explain severe emaciation, we conclude that it was caused mainly by undernourishment. Heavy parasite burden may have contributed substantially to the emaciation in some cases, with lung worm (see separate poster) and larva of warble fly and throat bot fly as the most important parasites.

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Parapoxvirus porojen suutaudin aiheuttajana 1999-2000

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Suomalaisissa poroissa on koko 1990-luvun ajan esiintynyt erityisesti talvisin suutautia, joka voi pahimmillaan johtaa poron kuolemaan. Suutaudille tyypillisiä oireita ovat ruokahalun heikkeneminen ja ikenissä, huulissa sekä kovassa kitalaessa olevat haavaumat ja rakkulat. Usein tautia pahentavat sekundaariset bakteeri-infektiot, jotka voivat levitä suun alueelta sisäelimiin. Suutauti leviää helposti; pahimman epidemiatalven (1992-93) aikana n. 400 poroa kuoli sairauteen ja sen aiheuttamiin jälkitauteihin ja n. 2800 eläintä tarvitsi eläinlääkärin hoitoa. Talven 1992-1993 epidemian aikana suutautinäytteistä löydettiin elektronimikroskooppisessa tutkimuksessa parapoxvirus, joka myöhemmin osoittautui orf virukseksi PCR-testissä Saksassa.
Tässä työssä kehitettiin talven 1999-2000 suutautiepidemian selvittämiseksi PCR menetelmät niin orf viruksen kuin muidenkin parapoxvirusten diagnostiikkaan. Samanaikaisesti pystytettiin myös PCR-menetelmä suomalaisissa poroissa yleisesti esiintyvän poron herpesvirus-1:n (RanHV-1) diagnostiikkaan. Näillä PCR-menetelmillä analysoitiin talvella 1999-2000 suutautia sairastaneiden porojen rupi -ja rakkulanestenäytteitä, jotka kaikki olivat negatiivisia orf -ja herpesviruksen osalta. Sen sijaan n. 18 % (9/49) tutkituista eläimistä oli positiivisia parapoxvirusspesifeissä PCR testeissä. Positiiviset PCR-tuotteet sekvensoitiin ja sekvenssejä verrattiin muihin tunnettuihin parapoxviruskantoihin, jotta talven 1999-2000 epidemian aiheuttajan mahdollinen sukulaisuus muihin parapoxviruksiin saataisiin selvitetyksi.

Parapoxvirus infection in Finnish reindeer 1999-2000

A contagious disease causing erosions, papules, pustules and ulcers in the mouth of reindeer has long been known in Finland escpecially during wintertime. Clinical signs of the disease are loss of appetite, fever, abundant salivation, difficulties to eat and pustules and ulcers in the mucosa of the oral cavity, tongue and lips. Secondary bacterial infections usually complicate the course of the disease.
The most severe outbreak in reindeer was during the winter of 1992-1993, when about 400 reindeer died and almost 2800 animals had clinical symptoms. The presence of parapoxvirus in clinical samples was demonstrated by electron microscopic studies; this diagnosis was later confirmed by an orf virus specific PCR in Germany. Since the 1992/93 outbreak the disease has occurred to a varying extent among reindeer in Northern Finland and caused considerable economic losses to reindeer husbandry. In this study we have developed diagnostic PCR´s for the detection of parapoxviruses in clinical samples in order to identify the causative agent of the 1999-2000 outbreak. A PCR method for detection of rangiferine herpesvirus-1 (RanHV-1) was also set up.
Analysis of scab- and lesion material of affected reindeers showed that the causative agent was not orf virus nor RanHV-1: none of the samples examined were positive in orf virus or RanHV-1 specific PCR´s. In parapoxvirus specific PCR´s, however, nine reindeer out of 49 (18 %) were found to be positive. The positive PCR products were sequenced and the sequences were compared to corresponding sequences of known parapoxviruses in order to find out the relationship between the current Finnish reindeer virus and other parapoxviruses.

Livstidsreproduksjonssuksess er ikke en funksjon med gjennomsnittlig levendevekt hos voksne rein

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Klare positive sammenhenger mellom kroppsmasse og fertilitet har blitt beskrevet i mange arter hjortedyr, fire underarter av rein (*Rangifer*) inkludert. I omtrent alle tilfeller har analysene vært basert på data samlet fra skutte prøver eller fra slaktet materiale (såkalte tverrsnittsprøver). Med slike data, tilfører hvert individ derfor bare et datapunkt til analysen. Denne metoden overser derfor nødvendigvis alle betraktninger om vedvarende, individuelle forskjeller i reproduktiv evne som er en egenskap hos mange arter. Vi viser her at kroppsmasse-fertilietets sammenhenger basert på data fra tverrsnittsprøver gir ingen grunn til å kunne forutsi det produktive potensiale til en bestemt rein. Livstidsreproduksjonssuksess (totalt antall kalver (okse- eller simlekalver) oppfostret til 4 mnd. i løpet av ei simles liv) ble målt i et enkelt årskull (født 1990, n = 43), i en tamreinflokk i Nord-Norge. Drektighet ble bestemt årlig ved hjelp enten av plasmakonsentrasjonen av progesteron, eller ved ultralyd. Tilstedeværelsen av kalv ble notert i september hvert år. Logistisk regresjon av de samlete data, som om de skulle være fra et tverrsnitt, viste at sannsynligheten for å ha en kalv i september, var sterkt relatert med kroppsvekt til simla høsten året før. Da de samme data ble reorganisert og analysert på nytt, gruppert ihht individuell livshistorie, og ved å bruke gjennomsnittlig livstids levendevekt i september (GLLS) som den uavhengige variable, forsvant effekten av kroppsmasse på reproduktiv evne. Antall kalver oppfostret til fire 4 mnd. av hver simle (gjennomsnittlig 4,6; spredning 0-6) økte med økende livslengde, men verken livslengde, totalt antall drektigheter, eller totalt antall kalver oppfostret hadde noen sammenheng med GLLS. Enkelte lette simler var veldig produktive, og enkelte tunge simler var veldig uproduktive. Ei simle hadde høyere sannsynlighet for å oppfostre en kalv hvis hun veide mer enn sin egen GLLS om høsten, uavhengig av om hun var lett eller tung i forhold til gjennomsnittlig kroppsmasse i kullet dette året. En enkel måling av kroppsmasse er derfor ikke nyttig for å kunne forutsi det reproduktive potensialet for en enkelt simle i denne flokken. Ei heller er det, i situasjoner hvor individuelle dyr blir selektert for slakt, nødvendigvis nyttig å måle kvaliteten til en flokk i form av flokkens gjennomsnittlig kroppsmasse.

Fertility is not a function of mean live body mass in adult female reindeer

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Significant positive correlations between body mass and fertility have been described in many species of cervids, including four sub-species of *Rangifer*. In virtually every case, however, analyses have been based on data collected from shot samples or from slaughterhouse material (so-called 'cross-sectional' samples). With data like these, each specimen contributes just one independent datum of a given type in the analysis. This approach, therefore, inevitably precludes all consideration of consistent, individual differences in reproductive performance which are a feature of many species of animals. We show here that body mass-fertility relationships based on data from a cross-sectional sample provide no basis for predicting the productive potential of an individual reindeer. Lifetime reproductive success (the total number of calves (male or female) reared to 4 *mo.* during the lifetime of a particular female) was measured in a single cohort of females (born 1990, $n = 43$) in a free-living, semi-domesticated herd of reindeer from northern Norway. Pregnancy was determined annually from the plasma concentration of progesterone or with ultrasound. The presence or absence of a calf was scored in September each year. Logistic regression analysis of pooled data, treated as though it had been drawn from a cross-sectional sample, suggested that the probability of pregnancy and of successfully weaning a calf was strongly related to live body mass (LBM) in September prior to the rut. However, when the same data were re-analysed, grouped by individual life history and using individual mean lifetime September LBM (MLSLBM) as the independent variable, the effect of body mass on reproductive performance vanished. The number of calves weaned per female (mean 4.6, range 0–6) increased with increasing lifespan but neither lifespan, nor the total number of pregnancies per individual, nor the total number of calves weaned per individual were correlated with MLSLBM. Some light animals were found to be highly productive; some heavy animals were unproductive. A female was more likely to wean a calf the following year if she had weighed more than her own MLSLBM in autumn, irrespective of whether she was heavy or light relative to the cohort mean LBM for that year. A single measurement of LBM is, thus, not useful for predicting the reproductive potential of an individual female in this herd. Nor, in situations in which individual animals are selected for slaughter, is it necessarily useful to measure the quality of a herd in terms of the herd mean LBM.

Innvirkning av reinsdyrbeiting på jordegenskaper på Finnmarksvidda

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I løpet av de siste 30 år er det i flere undersøkelser dokumentert at reinsdyrbeiting påvirker vegetasjonen på Finnmarksvidda. Det er kjent at jordegenskapene har avgjørende innvirkning på planteveksten og følgelig på produktiviteten i hele økosystemet. Likevel er det gjennomført få undersøkelser på hvordan reinsdyrbeiting påvirker jordegenskaper. Målet med denne undersøkelsen var å dokumentere eventuelle endringer i fysiske og kjemiske jordegenskaper som følge av reinsdyrbeiting. På fire lokaliteter på Finnmarksvidda ble det valgt ut 3 prøvesteder etter en subjektiv vurdering av tilstanden for lav og andre vekster: A) godt lav- og plantedekk; B) redusert lavdekke, men moderat påvirkning av andre planter; C) lav og andre planter nesten helt borte. Det ble antatt at forskjeller i lav og annen plantebestand var forårsaket av ulik beiteintensitet. De undersøkte vegetasjonstypene var lavrik fjellbjørkeskog og lav-lynghei. På hvert prøvetakingssted ble jordmonnet beskrevet og prøvetatt sjiktvis for fysiske og kjemiske jordanalyser. Fysiske parametre det ble analysert for var jordtetthet, porevolum, vann- og luftinnhold ved forskjellige sug, plantetilgjengelig vann og tekstur. Kjemiske parametre det ble analysert for var pH, organisk karbon (org.-C), Kjeldahl-N, kationbyttekapasitet (CEC), basemetning og plantetilgjengelig P, Ca, Mg og K. Resultatene viste at mineraljorda besto av siltig mellomsand med 1-3% leir. På prøvesteder med god lavvegetasjon var det organiske laget ikke mer enn 6 cm. Planterøtter var i hovedsak lokalisert til det organiske toppsjiktet, men en god del røtter var det også i de øverste 20 cm av mineraljorda. Tykkelsen på det organiske toppsjiktet avtok med avtakende tykkelse på lav- og plantedekke. Bare små forandringer i jordfysiske egenskaper ble funnet mellom de ulike prøvesteder. Det ble funnet en sterk korrelasjon mellom org.C i jorda og CEC for alle prøvesteder og sjikt. Videre hadde det organiske toppsjiktet høyest innhold av plantetilgjengelig P, Ca, Mg og K. Ved å gå ut fra at forskjellene i lav og annen vegetasjon er et resultat av ulik beiteintensitet, indikerer resultatene at reinsdyrbeitingen kan føre til en betydelig reduksjon av det organiske materialet. På de undersøkte lokalitetene på Finnmarksvidda må mengden organisk materiale i jorda betraktes som en av nøkkelfaktorene for jordfruktbarhet og dermed også økosystemets bæreevne og produktivitet.

Impacts of reindeer grazing on soil properties on Finnmarksvidda, Northern Norway

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Numerous investigations have documented changes in vegetation due to reindeer grazing in Finnmark County, Northern Norway, during the last 30 years. Soil properties are known to play an essential role for plant growth and thus ecosystem productivity. However, rather few investigations are done on the impact of reindeer grazing on soil properties. The aim of this investigation was to identify possible changes in physical and chemical soil properties due to reindeer grazing. At four different locations on Finnmarksvidda 3 sample sites were selected subjectively according to lichen and plant cover at each of the locations: A) good lichen and plant cover; B) reduced lichen cover, but moderate plant cover; C) lichen and plant cover almost absent. It was supposed that differences in lichen and plant cover were due to differences in grazing intensity. Vegetations types investigated were lichen rich mountain birch forest, and lichen heath. At each sample site one soil profile was excavated, thoroughly described and sampled for physical and chemical analysis from the different soil horizons. Physical parameters studied were soil density, soil porosity, water and air content at different suctions, plant available water and texture. Chemical parameters measured were pH, soil organic carbon (org.-C), Kjeldahl-N, Cation Exchance Capacity (CEC), base saturation, and plant available P, Ca, Mg, K. The results showed that the mineral soil at all sites consisted of loamy sand/sandy loam with about 1-3% clay. On sample sites with good lichen and plant cover, the thickness of the organic layer did not exceed 6 cm. Plant roots were mainly found in or directly below the organic layer, but could also be numerous in mineral B-horizons until the depth of 20 cm. The thickness of the organic-O horizons decreased with decreasing lichen and plant cover, while soil pH of organic-O horizons and mineral A-horizons increased with decreasing soil organic matter. Rather little changes in the soil physical properties of the mineral soil were found. A strong correlation was found between soil org.-C and CEC for all sites and horizons. Furthermore, organic-O horizons had generally the highest amounts of plant available P, Ca, Mg, K. Assuming that differences in lichen and plant cover are related to differences in grazing intensities, results indicate, that reindeer grazing can considerably reduce amounts of soil organic matter. At the investigated sites on Finnmarksvidda, soil organic matter is regarded as one of the most essential key factors for soil fertility, and thus ecosystem sustainability and productivity.

Estimering av effekt av insektplage, modellert ved hjelp av klimadata, på vekts hos reinsdyr om sommeren

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Kunnskap om atferd tyder på at insektsstress er den viktigste grunnen til at varme somre gir dårlig kondisjon hos reinsdyr. Jeg utvikler her en enkel indeks for insektplage (IHI), basert på klimaparametere som påvirker insektenes aktivitetsnivå. Denne indeksen er basert på temperatur, vindhastighet og skydekke, og blir videre brukt til a teste hypothesen "Insektplage har en negativ effekt på reinens produksjon", gjennom å analysere data fra tre norskereinbeitedistrikt.
Resultatene viser at økende IHI har negativ effekt på både bukke- og simlekalvers høstvekter. De påviste effektene oppstår sannsynligvis på grunn av redusert beitetid, økte energikostnader og redusert melkeinntak. Simlekalver ble gjennomgående rammet hardest av insektplagen, noe som kan påvirke framtidig reproduksjon. Dette antyder at blant klimarelaterte effekter kan insektplage være en nøkkelfaktor for å forstå reinens populasjondynamikk. Den presenterte indeksen er enkel å beregne, og kan brukes til å kvantifisere insektplagen i ulike sommerbeiteområder.

Use of climatic data to estimate the effect of insect harassment on summer weight gain in reindeer *(Rangifer tarandus)* calves

There is a lot of behavioural evidence supporting that harassment by insects is the most important causal link between warm summer temperatures and low body condition of reindeer, and that insect activity is influenced by weather condition. However much less is known regarding the effect of insect harassment on individual performance, measured as weight gain during summer for example. Using climatic data, this paper develops a simple index for the analysis of insect harassment that allows considering weather variables known to significantly affect insect activity and/or the level of insect harassment. The insect harassment index (IHI) which is based on ambient temperature > 13 °C, wind speed < 6 m/s and cloud cover < 40%, is further used to test the hypothesis that insect harassment has a negative effect on reindeer performance during summer in three Norwegian populations. Results show that insect harassment negatively affects autumn weight of both male and female calves, which lose up to 66 g per unit of IHI. This is most likely through reduced grazing time, increased energy expenditure and reduced lactation for calves. Female calves lost more weight than males. This effect may therefore have consequence on future reproductive performance, calving time, calf birth weight and neonatal mortality. Insect harassment may therefore be a key-climate related factor for the summer ecology of reindeer and caribou. The presented index is easy to estimate and may be used to quantify and compare harassment level at various reindeer summer grazing areas.

Fôring av avmagrede og underernærte reinsdyrkalver –fordypningsoppgave ved Norges veterinærhøgskole

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Bakgrunn
Reindrift i Norge er basert på gjeting av rein på utmarksbeite året rundt. Værforholdene gjør noen ganger at beitet er utilgjengelig på grunn av snø- og/eller isdekke. Når dette skjer, er kalvene spesielt utsatte for å dø av avmagring. For å hindre dette, prøver reingjeterne å ta seg av de svake kalvene. Kalvene blir tatt ned fra flokken, og fôret i gjerder nær huset. Jeg har imidlertid erfart at mange av disse kalvene dør etter 2-4 uker. Oppgaven min vil handle om hvordan man kan løse problemet med å fôre disse kalvene.

Relevante faktorer å utdype i dette studiet

- Valg av fôrtype: Høy, silo, pellets, lav. Bør bruk av mineralslikkestein anbefales?
- Betydning av mikrobiologisk fôrkvalitet: Mugg, listeria, andre agens?
- Betydning av ernæringsmessig fôrkvalitet: Innhold av protein, løselige karbohydrater, hemicellulose, cellulose og lignin. Hvordan er kvaliteten på det fôret som brukes i dag? Og hva slags kvaliteter anbefales?
- Overføring av vomsaft fra dyr med funksjonell vom – en måte å bedre fordøyelsen på hos dyr med sviktende vomfunksjon? En hjelp ved overgangsfôring?
- Tidspunkt for start av tilleggsfôring: Er kalvene i for dårlig form når fôringa starter?
- Arealbehov per rein i fôringsgjerdet.
- Effekt av å gi kalvene tilgang til vann, så de ikke behøver å bruke energi på å smelte snø. Vil kalvene benytte seg av fremsatt vann?
- Tilbakeføring til flokken: Hvordan velge det riktige tidspunkt?

Oppgaven skal gjennomføres våren 2003. Jeg er takknemlig for kommentarer til dette prosjektet, enten muntlig under konferansen, eller til min e-post adresse: weydahlh@hotmail.com

Feeding of emaciated and undernourished reindeer calves – a degree project at NVH

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Background
Reindeer herding in Norway are commonly based on natural pastures all through the year. Sometimes the snow and/or ice conditions may render the pastures inaccessible to the animals. Under such circumstances the calves are especially prone to succumb to starvation, and the herders try to pick up weak calves and transport them down from the winter pasture, to be fed in a fence near the house. However, in my experience, these calves very often die after 2-4 weeks. In my degree project I want to approach the problem of feeding these calves.

Relevant factors to be investigated in this study

- Which feed to choose: Hay, ensilage, pellets, lichens. Should licking-stones be recommended?
- The significance of microbiological feed quality: Mould, listeria, others?
- The significance of nutritional feed quality: Contents of protein, soluble carbohydrates, hemi-cellulose, cellulose and lignin. What is the quality of feeds used today? What is recommended?
- Transmission of rumen fluid from animals with a functioning rumen – a way to improve the digestion in animals with failing rumen function? A way to smoothen the adaptation to new feeds?
- How to find the right time to start supplemental feeding: Are the calves too emaciated when the feeding starts?
- Area needed in the feeding fence.
- Effect of giving the calves water, to make it unnecessary to use energy for melting snow. Will the calves make use of the water?
- The return to the herd and the natural pastures: How to find the right time?

The study will be performed in the spring 2003. I am grateful for any comments to this project, either orally during the conference or to my e-mail address: weydahlh@hotmail.com

Slaktkroppssammansättning i relation till vikt och kondition hos renkalvar

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Inom den svenska rennäringen diskuteras idag allt oftare betydelsen av en ökad produktion i renhjorden. Produktiviteten kan förbättras bl.a. genom: a) optimal anpassning av djurantalet till betesresursen så att god produktion kombineras med en tillräcklig storlek på renhjorden, b) optimal hjordstruktur med så stor andel högproduktiva djur som möjligt. Produktiviteten per djur har nära samband med djurens kondition (Danell, 1998). Hjordstrukturen kan påverkas genom olika slaktstrategier, där kalvslakt är ett vanligt alternativ för att öka renhjordens produktivitet (Helle & Kojola, 1993; Danell, 1998). I Finland har en produktionsmodell baserad på kalvslakt varit vanlig sedan början av 1970-talet, och idag domineras slaktstatistiken totalt av kalvslakt (Nieminen *et al.*, 1998).
Eftersom kalvar utgör en ökad andel av den svenska renslakten idag (60% av den totala slakten slaktsäsongen 1999/2000 (Statens Jordbruksverk, 2000)), är det viktigt att känna till kalvarnas slaktkropps-egenskaper. I denna undersökning studeras i vilken utsträckning kalvarnas storlek och kondition vid slakt påverkar slaktkropparnas egenskaper. Totalt ingick 75 renkalvar i undersökningen (50 handjur och 25 hondjur). Alla renar slaktades på slakteriet i Harads, Sverige (Arctic Deli AB). Vid slakt bedövades renarna med bultpistol före avblödningen. Slaktkropparna som ingick i undersökningen valdes ut under vinterslaktsäsongen (från november till mars) för att på bästa sätt beskriva säsongsvariationen och samtidigt slakta kalvarna vid normal tidpunkt på året. Alla slaktkroppar vägdes och klassificerades enligt EUROP-skalan för konformation och fettinnehåll innan de styckades. Samtliga slaktkroppar styckades i kommersiella detaljer och sorteringar och 21 av dem har totaldissekerats. Dissektion innebär uppdelning av slaktkroppen och de enskilda detaljerna i kött och ben. I den mån det finns något fett tas det bort ifrån kött och ben. Tekniken är densamma som tillämpas vid dissektion av slaktkroppar från nötkreatur, dovhjort, älg och gris (t.ex. Hansson & Malmfors, 1978; Hansson, 1997).
Alla slaktkroppar hade lågt innehåll av fettvävnad. De dissekerade slaktkropparna innehöll i genomsnitt 71,5% kött och 25,0% ben. Avsaknad av fett bidrog till att de lättare (< 20 kg) slaktkropparna hade 0,7% högre köttinnehåll än de tyngre (> 20 kg). Det var ingen signifikant skillnad i slaktkropparnas fettinnehåll när hon- och handjur jämördes. På de flesta slaktkroppar var lårmuskulaturen tillräckligt välutvecklad för att ge kommersiella styckningsdetaljer (benfria stekar).

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Carcass composition of reindeer calves in various physical condition

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Improved meat production in the reindeer herd is an important subject in today's Swedish reindeer industry. The production can be increased by: a) balancing the herd size to the pasture resources, and b) optimising the herd structure towards a high proportion of high-producing animals. The productivity of the herd is closely correlated to the physical condition of the animals (Danell, 1998). The herd structure can be influenced by different slaughter strategies, where an increased percentage of calf slaughter is a commonly used method to increase the meat production from the herd (Helle & Kojola, 1993; Danell, 1998). This method has been used in Finnish reindeer herds since the beginning of the 1970's and a large percentage of calf slaughter is today totally dominating the slaughter statistics (Nieminen *et al.*, 1998).
Since the number of reindeer calves slaughtered are increasing also in Sweden (60 percent of the total reindeer slaughter 1999/2000 (National Board of Agriculture, 2000)), it is important to investigate their carcass quality. A total of 75 reindeer calves were included in a study (50 males and 25 females) to evaluate the influence of body weight and physical condition on carcass characteristics. All reindeer were slaughtered at a commercial slaughter plant, Arctic Deli AB, Harads, Sweden. At slaughter the animals were stunned with a captive bolt. The carcasses were collected over the winter slaughter season, i.e. from November to March to represent the normal time of slaughter for reindeer calves and the seasonal variation in quality. Before cutting, all carcasses were weighed and graded for body conformation and fat content according to the EUROP grading system used in Sweden. All carcasses were cut into commercial details and 21 of the carcasses were completely dissected. Dissection means that the carcass is separated in various details and further into lean meat, fat and bone. The same technique has earlier been used for beef, lamb, pig, fallow deer and moose carcasses (i.e. Hansson & Malmfors, 1978; Hansson, 1997).
All carcasses had low content of fat tissue. The average lean meat and bone content were 71.5 and 25.0 percent respectively. The light carcasses (< 20 kg) had 0.7 percent higher meat content compared with the heavier (> 20 kg) ones, probably an effect of the low fat content. No significant difference in fat content was found between male and female calves. The muscularity of the hindquarter was good enough for most carcasses to give commercial cuts of high quality.

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Missbildningar hos renkalvar

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Enstaka fall av missbildningar har rapporterats hos ren (*Rangifer tarandus tarandus*), bl.a. gomspalt, över/underbett, navelbråck, vattenskalle, fiskfjällsjuka och onormalt antal ben. I ett projekt med övervakade kalvningar i naturhägn obducerades under fyra kalvningssäsonger alla döda kalvar under första levnadsmånaden. Sex fall med synliga missbildningar noterades (tabell 1), vilket är 3,8% av totalt 158 obducerade renkalvar, och medför en frekvens på 0,2% missbildningar av beräknat 2190 födda kalvar. Frekvensen missbildningar hos den studerade gruppen renar är inte högre än hos andra husdjur, men de funna missbildningarna har ärftliga faktorer hos andra djurslag och kan förväntas vara ärftliga även hos ren. I dagens traditionella renskötsel sker parningen helt opåverkat av människan, och avelsurvalet sker huvudsakligen bland vajorna, vilket sker under samlingar och skiljningar, medan infångade sarvar till större del slaktas. Missbildningar bland renar är dock sannolikt inte något problem för renpopulationen eller för rennäringen, då fribetande djur medför att svaga individer sållas bort av det naturliga urvalet, så att dåliga genetiska anlag inte sprids.

Malformations in reindeer calves

Single cases of malformations have been reported sporadically in semi-domestic reindeer (*Rangifer tarandus tarandus*), e.g. brachygnatia, cleft palate, omphalic hernia, hydrocephalus, icthyosis, and anomalous number of limbs.In a four-year study in Västerbotten, Sweden, of reindeer females calving under surveillance in enclosures, all dead calves were necropsied (all less than 1 month of age). Six visible malformations were documented (table 1.), which is 3.8% of the total 158 necropsied calves, and is a malformation frequency of 0.2% of the calculated 2190 calves born in enclosures during four calving seasons. The frequency of malformations is not higher than in other domestic animals, but all malformations found in the study are lethal for the individual and are known in other species to be inheritable. In traditional reindeer herding of today, breeding is usually uncontrolled by man, and selection of breeding animals is mainly done with females, as most males caught in the round-ups during autumn are slaughtered.. Malformations in semi-domesticated reindeer is probably not a problem for the population or the herd management, as nature quickly eliminates individuals unfit to survive in the wild, stopping all extensive spread of such genetic material.

Fall/ Case no.	**Missbildning / Malformation**
1-2	Gomspalt (GS)/cleft palatae (CP) (palatoschisis)
3	GS, underbett/CP, shortened upper jaw (palatoschisis, brachygnatia maxilla)
4	GS, harmynt/cp, lip and upper jaw (cheilo-gnatopalatoschisis), kroksvans/crooked tail (defect tail vertebrae), hjärtmiss-bildning (ventricular septumdefekt)/ heart malformation (ventricular septal defect), avsaknad av vänster njure, rektum och anus/aplasia of left kidney, rectum and anus (agenesis ren, atresia ani/rectum).
5	Arthrogryposis (AG) (muskelkontraktioner) med snedställning i bröstryggkotpelare och ledkontraktur i båda bakbenen/ AG (muscle contractions) with torticollis, thoracic vertebral deviation, and ankylosis in both hind limbs.
6	Hjärtmissbildning, ej definierad (bortkommet preparat p.g.a. felmärkning)/heart malformation, undefined (lost due to mislabeled specimen).

Tabell/Table 1. Påvisade missbildningar bland 158 obducerade renkalvar under en månads ålder, åren 1997-2000. / Diagnosis of malformations found at necropsy of 158 reindeer calves, less than 1 month of age, in 1997-2000.

Orsaker till perinatal dödlighet hos renkalvar i hägn

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Kalvöverlevnaden är av avgörande betydelse för produktiviteten inom rennäringen. Studier på kalvförluster från kalvmärkning (ca två månaders ålder) och framåt hade tidigare utförts i Sverige, men ej från förlossning till kalvmärkning p.g.a. svårigheten att bland fribetande renar återfinna döda spädkalvar. I Västerbottens Län utfördes försök med övervakad kalvning i hägn under fyra kalvningsperioder (1997-2000). Hagarna bevakades större delen av dygnet mot rovdjur. Kalvningar övervakades och döda kalvar obducerades. Under hägnperioden var kalvförlusten i medeltal 7,5%. Våren 2000 var vajorna uppdelade i hagar efter kroppsvikt, och då noterades att kalvdödligheten i hagen med mindre vajor (<60 kg) var dubbel så hög som i hagen med vajor >60 kg. Den dominerande förlustorsaken "utmärglad/övergiven" som sågs vid obduktion av de totalt 124 funna döda kalvarna under hägnperioden (diagram 1) kan antas bero på antingen svagfödda kalvar eller dåliga modersegenskaper. Preliminära beteendestudier tyder på att kalvning i hägn i sig inte stör kalvningen eller moder-kalvkontakten. Med undantag för ett år kunde predation uteslutas som förlustorsak i hägnen. Den tidiga kalvdödlighet som noterats i hägnet bör i vissa delar kunna spegla kalvförlusterna även bland frigående renar, men att större rovdjursförluster kan förväntas, och att antalet infektioner troligen är mindre. Studien visar att skötsel- och övervakningsinsatser under hägnperioden har avgörande betydelse för att minska tidiga kalvförluster orsakade av olyckor, infektioner och rovdjur. Livdjur ska helst selekteras avseende goda modersinstikter och anpassningsförmåga till systemet med övervakad kalvning i hägn, för att förbättra kalvöverlevnaden.

Causes of perinatal mortality in reindeer calves

Reindeer calf survivability is crucial to the productivity in reindeer herding. Calf mortality has in Sweden mainly been studied from the age of about two months, at the time of summer calf marking, and onwards, due to the problem of finding carcasses in the field to study the perinatal mortality. In a four year study (1997-2000) in Västerbotten county, Sweden, reindeer females were kept in a large enclosure during the calving seasons, to calve under close surveillance. The surveillance included deterring predators, spotting reindeer with calving problems or disease, and finding deceased calves to be necropsied. The calf mortality in the enclosures was in average 7,5%. In the Spring of 2000 the females were separated into different enclosures according to body weight at the time. Calf mortality was in the >60 kg group found to be only half of that in the group of females <60 kg. In the 124 necropsied reindeer calves found dead during four calving seasons, the single dominating cause of death was "emaciation/abandonment" (figure 1), which could have been due to either weak-born "fading" calves, or poor maternal instincts in the females. Preliminary ethologic studies in the enclosures did not show that calving or mother–calf bonding was disturbed by the fenced-in situation. Infections can be expected to be a problem not found in free-ranging animals whereas predation in the enclosures could be excluded, except for bear attacks one year. The study shows that good management and appropriate hygienic measures are crucial to keep the calf losses as low as possible. Selection of breeding stock with good maternal instincts and adjustability to the situation of calving under surveillance in enclosures should also improve calf survivability.

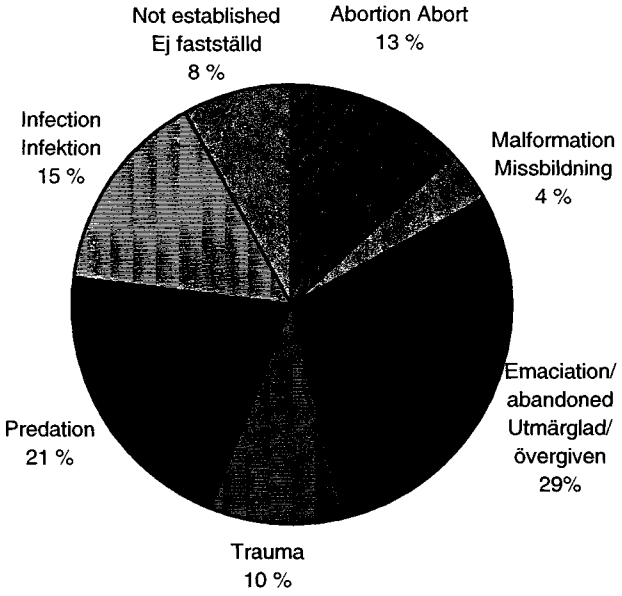

Diagram 1. Causes of perinatal calf losses in reindeer calving in enclosures, 1997-2000. Total number of necropsied reindeer calves (aged 0-1 month); 124. Average calf loss per year 7,5 %. All predation was due to three attacks by brown bear in 1998.

Diagram 1. Tidiga kalvförluster hos vårhägnade vajor under 1997-2000, fördelade på förlustorsaker. Totalt 124 aborterade eller födda kalvar som obducerats, ingår. Medelförlust per år 7,5 %. All predation skedde vid tre björnbesök 1998.

Smältbarhet av lav och ensilage i vomvätska från ren

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En enkel *in vitro*-metodik för att uppskatta smältbarheten av vallfoder (VOS = vomvätskelöslig organisk substans) andvänds som rutinmetod vid SLU för att bedöma foder till nötkreatur. Vi har jämfört smältbarhet *in vitro* och *in vivo* för tre olika foder, lav (*Cladina* spp.) och två kvaliteter av blandat gräs-ensilage (första och andra skörd), för att ta reda på om VOS kan användas också för att bedöma foder till renar.
Tio renar gavs tre blandade dieter (80% lav och 20% ensilage eller 20% lav och 80% av endera av de två ensilagen) i en change-over design. Varje diet gavs under 14 dagar och träck samlades under de sista 5 dagarna. Den skenbara smältbarheten *in vivo* av de olika dieterna beräknades som utfodrad minus avgiven organisk substans i träcken i % av utfodrad mängd. Vid beräkning av smältbarheten för de enskilda foderslagen antogs att det inte var några interaktioner mellan foderslagen. Vomvätska från slaktade renar utfodrade med de olika dieterna användes för att mäta VOS. Värdet på VOS användes för att uppskatta smältbarhet *in vitro* av de olika foderslagen med hjälp av en kalibrering gjord för nötkreatur.
De beräknade smältbarheterna skiljde sig endast marginellt från de uppmätta värdena *in vivo*. Smältbarheten var lägst för lav (72% smältbar organisk substans enligt VOS och 74% enligt *in vivo* mätningarna), och högst för ensilage från första skörd (77% enligt VOS och 76% *in vivo*). Värdena för VOS i lav blev lägre när vomvätska från ren som inte gått på lavdieten användes, medan VOS i ensilage inte var beroende av vomvätskedonator. De lavutfodrade renarna hade signifikant högre foderintag (räknat som torrsubstans) än de renar som fick mest ensilage. Det kan vara så att uppehållstiden i vommen är kortare för lav än för ensilage, som en effekt av olikheten i struktur. Detta skulle då resultera i en större vomfyllnad hos de renar som utfodrats med huvudsakligen ensilage (vilket också observerades vid slakt) och möjligen ha negativ effekt på foderintaget.
Vår slutsats är att den använda metodiken för att mäta VOS kan användas för att bedöma smältbarhet för ren i de undersökta foderslagen. Den kalibrering som används för nötkreatur ger en bra uppskattning av smältbarheten i dessa foder. Vi fick olyckligtvis väldigt liten skillnad i smältbarhet mellan de olika foderslagen. Ytterligare studier behövs därför, för att fastställa om relationen mellan smältbarhet *in vitro* och *in vivo* är densamma även för andra foderslag, speciellt de som har en mycket låg eller mycket hög smältbarhet.

Digestibility of lichens and silage in reindeer rumen fluid

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A simple *in vitro* method to assess the digestibility of silage and hay (VOS = rumen organic matter digestibility) is used as a routine procedure at SLU for evaluation of feeds to cattle.
We compared *in vitro* and *in vivo* digestibility of three different feeds, lichens (*Cladina* spp.) and two qualities of mixed grass silage (first and second harvest), to find out if VOS can be used also to evaluate forages to reindeer.
Ten reindeer were given three mixed diets (80% lichens and 20% silage or 20% lichens and 80% of either of the two silages) in a change-over design. Each diet was given for 14 days and faeces were collected during the last 5 days. *In vivo* apparent digestibility of the mixed diets was calculated based on organic matter intake and faecal excretion. The digestibilities of the single feeds were then calculated, by differences, assuming no interactions between the feeds. Rumen fluids from slaughtered reindeer fed the same diets were used to measure VOS. The VOS value was used to estimate digestibility of the different feeds, using a formula based on calibrations made for cattle.
The estimated digestibilities differed only marginally from those measured *in vivo*. Digestibility was lowest for lichens (72% digestible organic matter according to VOS and 74% according to *in vivo* measurements) and highest for silage from the first harvest (77% according to VOS and 76% *in vivo*). Lower VOS for lichens was obtained when the rumen fluid was taken from a reindeer eating mainly silage, while VOS for silage did not depend on rumen fluid donor. The lichen fed reindeer had a significantly higher dry matter intake than the silage fed reindeer. It might be that the retention time in the rumen is longer for silage than for lichens, because of the difference in structure. This would then result in a greater rumen fill (which was also observed at slaughter) and possibly have a negative effect on feed intake.
We conclude that the tested VOS procedure can be used to estimate digestibility of the forages to reindeer. The calibration obtained for cattle gave good estimates of digestibility for these feeds. However, we were unfortunate in getting a narrow range of digestibilities in this experiment and further investigation have to be made to examine if the relationship between *in vitro* and *in vivo* digestibility is the same for other feeds, especially those with very low or very high digestibilities.

Reinens hudbrems - *Hypoderma tarandi* – om egenskaper ved førstestadiumslarven

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Reinens hudbrems eller gormflua (*Hypoderma tarandi*), en reinparasitt med ett-årig livssyklus, forårsaker driftsproblemer og økonomiske tap i reindriften og regnes som den av reinparasittene som kanskje har størst økonomisk betydning. Den parasittiske larven forårsaker en tilstand kjent som "cutaneous myiasis", noe som innebærer generell svekkelse av dyret og nedsatt beitingsaktivitet, allergiske reaksjoner, sekundære infeksjoner med mikroorganismer, hudskader som gir plager for reinen og redusert skinnverdi for eieren, og ved svært høye antall kan larvene være en direkte dødelighetsfaktor. Effektive antiparasittmidler, slik som ivermektin, er tilgjengelig for å redusere parasittbelastningen. Det meste av ivermektindosen kommer imidlertid ut igjen relativt uforandret gjennom avføringen. Dette, sammen med eventuell resistensutvikling som følge av langvarig bruk av antiparasittmiddel, fører til bekymring for mulige uønskete økologiske virkninger. Om andre anti-parasittstrategier kunne utvikles kunne det være av stor betydning, og ervervelse av mer basiskunnskap omkring larvens biologi og levemåte er grunnleggende i slik sammenheng.
Av hudbremsens tre larvestadier er det den nyklekte førstestadiumslarven som først møter reinen og reinens immunapparat. Prosjektet, som har økonomisk støtte fra Reindriftens utviklingsfond, Alta, gjennomføres i første omgang studier av histologisk og immunhistologisk sammensetning av førstestadiumslarven, og foreløpige resultater fra dette presenteres.

Reindeer warble fly - *Hypoderma tarandi* – histological and immuno-histological properties of the 1st instar larvae

The reindeer warble fly (*Hypoderma tarandi*), a parasite with a one-year life cycle, causes management problems and economic losses in reindeer husbandry and is often considered the probably most economically significant parasite of reindeer. The parasitic larvae cause cutaneous myiasis, generally resulting in weakness and decreased grazing vitality, allergic responses, skin damage, secondary infections by micro-organisms, and at high densities the larvae can be a direct mortality factor. Effective broad-spectrum antiparasitic drugs such as ivermectin are available to control the parasite burden, but most of the ivermectin dose is excreted relatively unaltered in the feces. This, together with the possibility of resistance development resulting from long term use of the drug, cause concern of possible impacts on reindeer pasture ecology. If other strategies could be developed, this could be of great importance, and in this context acquirement of more of basic knowledge of the biology and mode of life of the larvae is important.
Of the three stages of the warble fly larvae, the newly hatched 1st instar larvae is the first one to meet the reindeer and the reindeer immune system. In the project, which is economically supported by the Reindeer Husbandry Development Fund, Alta, the first part is related to properties of the 1st instar larvae with respect to histology and immuno-histology. Preliminary results are presented.

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