TARANDUS

Photo: Ingebjørg H. Nymo

TARANDUS CONFERENCE

10TH–12TH FEBRUARY 2026

LULEÅ, SWEDEN

Welcome to the fourth Tarandus conference which focuses on Reindeer welfare, health and resilience. The conference is coordinated by the Swedish Veterinary Agency, LUKE Natural Resources Institute Finland, the Norwegian Veterinary Institute and the Norwegian Reindeer Health Advisory Service (Reinhelsetjenesten). The TARANDUS network gathers reindeer researchers from Finland, Iceland, Norway, and Sweden and further afield.

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This is TARANDUS

The TARANDUS network is a collaborative platform that brings together researchers, veterinarians, and stakeholders who work with reindeer health and welfare. It was established in 2021 to help address the growing challenges facing reindeer husbandry, especially those caused by climate change.

Why is it needed?

Reindeer husbandry is vital in northern Fennoscandia because it:

- Supports local food security, particularly in remote areas and is central to Sámi livelihoods, culture, and history
- Contributes to crisis preparedness, including during emergencies or conflict
- Provides ecosystem services, such as controlling shrub encroachment and preserving biodiversity

However, climate change is making winters more unstable, with frequent freeze–thaw cycles that create ice-covered pastures. This limits access to natural grazing and forces herders to rely more on supplementary feeding, which can lead to increased stress, disease and altered behaviour in reindeer and place considerable physical and economic burden on the herders.

Why is it important?

By connecting around 100 active members across Fennoscandia and further afield, the Tarandus network strengthens preparedness and resilience in reindeer husbandry. It helps ensure that reindeer production remains sustainable, climate-adapted, and low-impact, while protecting animal welfare and supporting Sámi culture and northern food systems in a rapidly changing climate.

What does the TARANDUS network do?

The network: provides a forum for sharing knowledge on reindeer health and welfare

- Discuss disease outbreaks and emerging risks, encourage collaboration and new research projects, and supports climate-adapted preventive management practices
- Creates opportunities for PhD students and early-career researchers to learn, network, and present their work through student travel grants of which six were awarded for this conference

MORE ABOUT TARANDUS
https://www.sva.se/djurhaelsa/djurslag-a-oe/produktionsdjur/ren/tarandus-naetverket/the-tarandus-network/

Photo: Ingebjørg H. Nymo

Scientific Program

Time (CET)	Detail	Speaker

Tuesday 10th February

11:30-12:30	Registration	
12:30-13:30	Lunch	
13:30-13:45	Welcome and house rules	Anna Omazic and Sanna Illman, Swedish Veterinary Agency, Sweden

Session 1: Reindeer Welfare

Moderator: Ingebjørg H. Nymo

13:45-14:15	Reindeer Welfare – research and regulations	Charlotte Berg, Swedish University of Agricultural Sciences, Sweden
14:15-14:45	Castration pain and pain alleviation in semi-domesticated reindeer	Hanna Nurmi, Reindeer Herders' Association, Finland
14:45-15:05	Reindeer herders' perceptions of contagious ocular disease in reindeer: a one welfare perspective based on a qualitative interview study in sweden	Karin Wallin Philippot, Swedish Veterinary Agency, Swedish University of Agricultural Sciences, Sweden
15:05-15:15	Guidance on assessing whether the reindeer is fit for transport to slaughter	Ulrika Rockström, Farm and Animal Health, Sweden
15:25-15:45	Coffee	

Session 2: Reindeer Health

Moderator: Juha Kantanen

15:45-16:05	First detection of pseudocowpox virus in a reindeer herd in Sweden	Maria Olsson, Swedish Board of Agriculture's District Veterinary Organisation, Sweden
16:05-16:15	Experiencing cervidpox in an isolated reindeer herd	Renate Thorvaldsen, UiT The Arctic University of Norway, Norway
16:15-16:25	Seroprevalence of alphaherpesvirus and pestivirus in reindeer in Sweden	Emelie Peterson, Swedish University of Agricultural Sciences, Sweden
16:25-16:45	Zoonotic pathogens in semi-domesticated Eurasian tundra reindeer	Morten Tryland, University of Inland Norway, Norway
16:45-16:55	Stored lichen as supplementary feed for reindeer: A pilot study on hygienic quality	Josefine Elving, Swedish Veterinary Agency, Sweden
16:55-17:05	Perspectives of the deer ked infestation on reindeer in Finland	Sanna-Mari Kynkäänniemi, University of Oulu, Finland
17:05-17:15	Insect relief for reindeer	Mikaela Sauvala, University of Helsinki, Finland

End of day 1 program

19:00	Dinner at Quality Hotel	

Time (CET)	Detail	Speaker

Wednesday 11th February

Session 3: Reindeer Health

Moderator: Karin Wallin Philippot

09:00-09:05	Welcome to day 2	Karin Wallin Philippot, Swedish Veterinary Agency, Sweden, Swedish University of Agricultural Sciences, Sweden
09:05-09:25	Reindeer healthcare	Sauli Laaksonen, University of Helsinki, Finland
09:25-09:45	Remote digital necropsies (RDN) of reindeer in Finland	Laura Itkonen, Finnish Food Authority, Finland
09:45-10:05	Efficacy of subcutaneous ivermectin against gastrointestinal parasites in Fennoscandian reindeer	Sauli Laaksonen, University of Helsinki, Finland
10:05-10:35	Ivermectin treatment failure of gastrointestinal parasite infections in fenced reindeer	Peter Halvarsson, Swedish University of Agricultural Sciences, Sweden
10:35-11:05	Coffee	
11:05-11:25	*Giardia* and *Cryptosporidium* in reindeer (*Rangifer tarandus*) calves	Kjersti Selstad Utaaker, Norwegian Veterinary Institute, Norway
11:25-11:45	Re-emergence of *Setaria tundra* in Finnmark, Norway, after nearly half a century with no detection	Rebecca K. Davidson, Norwegian Veterinary Institute, Reindeer Health Advisory Service, Norway
11:45-12:05	ReMoST-ABM: Reindeer-Mosquito-Setaria-Tundra Agent Based Model	Stephania Zneimer, University of Colorado, USA.
12:05-12:15	Worms on the brain: modelling climate impacts on brainworm (*Elaphostrongylus rangiferi*) transmission risk in Norwegian reindeer herds (*Rangifer tarandus* ssp.)	Anna Ciezarek, University of Liverpool, United Kingdom
12:15-13:30	Lunch	

Session 4: Reindeer Resilience

Moderator: Rebecca K. Davidson

13:30-14:00	Resilience of Norwegian wild reindeer – thoughts from a wildlife veterinarian	Bjørnar Ytrehus, Norwegian Veterinary Institute, Norway
14:00-14:20	Strengthening crisis preparedness and resilience in Sámi reindeer herding communities	Anna-Marja Kaddik, Sámiid Riikkasearvi (Sámi Reindeer Association), Sweden
14:20-14:30	Establishing a centre for veterinary disaster medicine – safeguarding animal health, welfare and food security	Ulrika Nordling, Swedish Veterinary Agency, Swedish University of Agricultural Sciences, Sweden
14:30-14:50	Seasonal gene expression profiling of domestic reindeer (*Rangifer tarandus tarandus*)	Juha Kantanen, Natural Resources Institute, Finland
14:50-15:20	Coffee	
15:20-15:40	How to adapt to multiple stressors in reindeer husbandry?	Anna Skarin, Swedish University of Agricultural Sciences, Sweden

End of day 2 program

19:00	Dinner at Quality Hotel

Time (CET)	Detail	Speaker

Thursday 12th February

Session 5: Reindeer Resilience

Moderator: Anna Omazic

09:00-09:05	Welcome to day 3	Anna Omazic, Swedish Veterinary Agency, Sweden
09:05-09:35	Drones in reindeer husbandry	Gabriela Wagner, NIBIO, Norway
09:35-09:55	Development in reindeer husbandry: Bottom-up approach	Kirsi Muuttoranta, Lapland University of Applied Sciences, Finland
09:55-10:05	Fine-scale movement of reindeer (*Rangifer tarandus t.*) calves in summer in forest and alpine habitats	My Strömgren, Swedish University of Agricultural Sciences, Sweden
10:05-10:35	Coffee	
10:35-10:55	Optimizing herd structure and calf weights to mitigate effects of climate change	Lars Rönnegård, Swedish University of Agricultural Sciences, Dalarna University, Sweden
10:55-11:05	Defining and evaluating "grazing peace" of reindeer in relation to disturbances (REINPEACE)	Heidi Rautiainen, Swedish University of Agricultural Sciences, Sweden
11:05-11:15	Exploration of photoreceptive adaptations in a polar cervid (*Rangifer tarandus tarandus*)	Emer Flanagan, UiT The Arctic University of Norway, Norway
11:15-11:45	Final remarks	
11:45-13:00	Lunch	
13:00	End of day 3 program	

ABSTRACTS

Photo: Rebecca Davidson

Tuesday 10th February

Session 1: Reindeer Welfare

Reindeer welfare – research and regulations

Berg, Charlotte ('Lotta')[1]
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The term 'animal protection' is used when referring to human actions and responsibilities; what humans do, do not do, or should do for animals. 'Animal welfare' refers to the experience of the individual animal and how well it can cope with its situation. The World Organisation for Animal Health (WOAH) states that 'Animal welfare refers to the physical and mental state of an animal in relation to the conditions in which it lives and dies'. Hence, the concept of animal welfare can be applied to any species, including reindeer, regardless of the degree of domestication. Current protection and welfare aspects discussed for reindeer can be related to e.g. climate, feed availability, handling and tameness, risk of predation, traffic accidents, development projects and tourism, infections and parasites, the possibility of daily supervision, pain management and fitness for transport - especially in relation to velvet antlers - and slaughter. In some of these fields, there is an obvious need for more research. In other fields, the discussion is mainly related to the compliance with AW legislation, where there are particular challenges related to the specific conditions under which reindeer are kept. Positive welfare aspects of reindeer husbandry practices will also be highlighted.

Castration pain and pain alleviation in semi-domesticated reindeer

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[1]Reindeer Herder's Association, Finland
[2]University of Helsinki, Finland

An estimated 2,500–4,000 reindeer bulls are castrated yearly in Finland, previously without pain relief. Studies in other ruminants clearly show that clamp castration is painful, making effective analgesia a key welfare requirement. The new Animal Welfare Act (693/2023) mandates pain alleviation for painful procedures. However, little has been known about how reindeer display castration pain or how analgesia can be practically administered. Reindeer are highly reactive to human contact. Field anesthesia poses risks, and capture or prolonged restraint may lead to severe stress. Pain management in reindeer is further complicated by their markedly reduced winter metabolism, which may alter drug pharmacokinetics. Sedatives and anesthetics can have dangerous side effects, particularly during winter and in fast-paced round-ups, and antagonists are not approved for food-producing animals. Local anesthesia increases handling time, while evidence for non-steroidal anti-inflammatory drugs (NSAIDs) in reindeer has been lacking. Presentation provides the first pharmacokinetic study of an NSAID—meloxicam—in reindeer, demonstrates key pain-related behaviours, assesses the limitations of local anesthesia, and shows that meloxicam offers effective relief for 2–3 days after castration, though not during the procedure itself.

Herders' perceptions of contagious ocular disease in reindeer: a one-welfare perspective based on a qualitative interview study in Sweden

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[3]Department of Applied Animal Science and Welfare, Swedish University of Agricultural Sciences, Uppsala, Sweden;
[4]Department of Chemistry, Environment and Feed Hygiene, Swedish Veterinary Agency, Uppsala, Sweden;
[5]Department of Economics, Swedish University of Agricultural Sciences, Uppsala, Sweden; [6]Department of Applied Animal Science and Welfare, Swedish University of Agricultural Sciences, Skara, Sweden

Infectious keratoconjunctivitis (IKC) in reindeer is a contagious ocular disease with significant consequences for animal health and welfare, including pain, impaired vision, reduced ability to follow the herd or locate food, and, in severe cases, increased risk of mortality. Although IKC has long been recognized in reindeer, its occurrence appears to have increased in recent decades. Health risks associated with

altered management practices, due to competing land use and climate change, may significantly affect both animal welfare and herders' livelihoods. For herders, cases or outbreaks of IKC may lead to practical challenges, additional workload, emotional strain, and economic losses. This highlights the relevance of applying a One Welfare perspective where animal health, human wellbeing, and the environment are interconnected. Semi-structured interviews were conducted to explore reindeer herders' perceptions and experiences of contagious ocular disease, including the effects on reindeer and herder, through the framework of One Welfare. The results of a thematic analysis will be presented during the conference.

Guidance on assessing whether the reindeer is fit for transport to slaughter

Rockström, Ulrika[1]; Kaddik, Anna-Marja[2]; Olsson, Maria[3]
[1]Farm & Animal Health, Uppsala, Sweden; [2]Sámiid Riikkasearvi, Umeå, Sweden; [3]The Swedish Board of Agriculture's District Veterinary Organisation, Kalix, Sweden.

EU transport legislation requires that animals transported are "fit for transport". In Sweden, guidance documents exist for assessing most farm animals before and after transport; however, no such guidance is currently available for reindeer. As a result, many reindeer herders and transporters experience uncertainty and concern about the risk of making incorrect assessments. Assessing reindeer prior to transport can be particularly challenging due to demanding conditions such as darkness, cold temperatures, and time pressure, as loading must be carried out efficiently to minimize stress for the animals. The most relevant assessment areas for reindeer include lameness, diarrhea, large antler crowns, velvet antlers, eye infections, emaciation, and injuries such as wounds or broken antlers. The guidance currently under development aims to clarify the threshold between acceptable and non-acceptable conditions within each assessment area. The guidance will be discussed in collaboration with the Swedish Board of Agriculture. The overall objective is to improve knowledge and consistency in fitness-for-transport assessments, thereby enhancing animal welfare and increasing confidence among reindeer herders and transporters. Incorrect assessments may otherwise lead to the transport of animals not fit for transport and thereby also a report of the reindeer herder/transporter or, in severe cases, prosecution following inspection by an official veterinarian at the slaughterhouse.

Session 2: Reindeer Health

First detection of pseudocowpox virus in a reindeer herd in Sweden

Olsson, Maria[1]; Andersson Kristoffer[2]; Wallin Philippot Karin[3]
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[2]Department of Microbiology, Swedish Veterinary Agency, Uppsala, Sweden;
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In semi-domesticated reindeer (*Rangifer tarandus tarandus),* Orf virus (ORFV) and pseudocowpoxvirus (PCPV) have been described as the causative agents of outbreaks in Fennoscandia, belonging to the genus parapoxviruses (PPV). Clinical signs include severe crusty lesions, especially on the muzzle and in the oral mucosa. These lesions may lead to secondary bacterial infections, impairing the ability to eat, and consequently, to starvation and mortality. In October 2025, samples were collected from a reindeer herd in Tornedalen, Sweden, following an outbreak of ocular disease in reindeer calves that began in June 2025. The reindeer were free grazing in the forest until October, when samples were collected during the first gathering for slaughter. Nine calves and one yearling presented with clinical signs of ocular infection (tearflow, pus, conjunctivitis and keratitis), were sampled by rubbing an eSwab™ over the conjunctiva of one affected eye. Analysis at the Swedish Veterinary Agency (SVA) revealed that five calves tested positive for Chlamydia and three for PPV by qPCR. Partial Sanger sequencing (563 bp) was successfully performed on one PPV-positive sample. A BLASTn search showed the highest sequence similarity to PCPV, representing the first detection of PCPV in a reindeer herd in Sweden.

Experiencing cervidpox in an isolated reindeer herd

Thorvaldsen Renate[1], Folkow Lars P[2], Lian Hans [2], Nymo Ingebjørg H.[1,2]
[1]Norwegian Veterinary Institute, Tromsø, Norway; [2]UiT – The Arctic University of Norway, Tromsø, Norway

At the University of Tromsø, Avdeling for Arktisk Biologi, a small reindeer herd has been maintained for research purposes for approximately 50 years. In 2022, what initially appeared to be a routine eye infection in a few animals rapidly escalated into a widespread outbreak affecting most of the herd. The causative agent was later identified as the cervidpox virus. Leveraging the unique research facilities available, we conducted detailed surveillance of the outbreak, enabling us to closely monitor the progression of the disease in individual animals. This presentation will focus on the detection and management of the outbreak, with particular emphasis on the dynamics of clinical symptoms and recovery patterns within the herd. The presentation goal is to provide an overview of the outbreak and contribute to a broader understanding of cervidpox in reindeer. While our findings are specific to this herd, we hope they can offer useful insights for others working with reindeer or managing similar disease outbreaks.

Seroprevalence of alphaherpesvirus and pestivirus in reindeer in Sweden

Peterson, Emelie[1]; Wallin Philippot, Karin[1,2]; Johansson Wensman, Jonas[1,2]
[1]Swedish University of Agricultural Sciences, Sweden; [2]Swedish Veterinary Agency, Sweden

Cervid alphaherpesvirus 2 (CvHV2), is known to cause infectious keratoconjunctivitis (IKC) and other mucosal lesions in reindeer. The effects of pestivirus are less known, however, its association to reproductive losses in other ruminant species is well established. This study estimated the seroprevalence of alphaherpesvirus and pestivirus in reindeer in Sweden. Blood samples from 310 reindeer across six herding districts, collected between 2020 and 2022, were analyzed for virus-specific antibodies to determine the seroprevalence in reindeer calves (<1 year) and adults (>1 year). The overall seroprevalence was 37.1% for alphaherpesvirus and 28.4% for pestivirus. The seroprevalence was compared between regions to assess geographical differences and with findings from previous studies to evaluate temporal trends. The seroprevalence of pestivirus was significantly higher in Norrbotten county compared to Dalarna/Jämtland, while the seroprevalence of alphaherpesvirus was significantly higher in Västerbotten county than both Norrbotten and Dalarna/Jämtland. The results were also compared with a previous study analyzing serum samples from a specific herding district for pestivirus, indicating a break in a previously declining trend. Considering the observed seroprevalence, continued animal health surveillance and additional studies on the impact of these viruses on reindeer health and welfare are warranted.

Zoonotic pathogens in semi-domesticated eurasian tundra reindeer

Tryland, Morten[1]; Buhler, Kayla J.[1]
[1]Department of Forestry and Wildlife Management, University of Inland Norway, Koppang, Norway

Norway, Sweden and Finland are together hosting about 640 000 semi-domesticated Eurasian tundra reindeer (*Rangifer tarandus tarandus*). Since they are free-ranging most of the year, they may reflect the pathogens circulating in their ecosystems, especially those infecting wild and livestock ruminants. Due to loss and fragmentation of pastures along with climate change, supplementary feeding has become more common, representing increased contact between animals and herders. The average consumer eats about 100, 300 and 400 gr meat per person, in Sweden, Norway and Finland, respectively. In contrast, reindeer meat and products constitute a much larger part of the diet to members of herding communities, often without thorough heat treatment (e.g., dried, cured, smoked or raw) increasing the risk of transmission of potential pathogenic parasites (e.g., *Toxoplasma gondii*, *Echinococcus granulosus*), bacteria (e.g., Salmonella sp., *Brucella suis*, *Mycobacterium bovis*) and viruses (e.g., Parapoxvirus). Through a recent systematic review, we concluded that the zoonotic threat from reindeer in Fennoscandia currently is of restricted magnitude. However, feeding practises and climate change, with altered ecological conditions for insect vectors and ticks, may potentially introduce pathogens new to the host and region. Thus, we need to be prepared for emerging infectious diseases in reindeer and man.

Stored lichen as supplementary feed for reindeer: a pilot study on hygienic quality

Elving, Josefine; Kaddik, Anna-Marja [2]; Omazic, Anna [1]
[1]Swedish Veterinary Agency, Sweden; [2]Sámiid Riikkasearvi, Sweden

In early 2024, a pilot study was carried out to generate knowledge on the hygienic quality of lichen used as supplementary feed for reindeer. The study was conducted in collaboration between the Swedish Veterinary Agency (SVA) and Sámiid Riikkasearvi (SSR). Through this cooperation, reindeer herders were invited to submit lichen samples free of charge from their own stored feed stocks. In total, 17 lichen samples were analysed for hygienic quality. Of these, 13 samples showed varying degrees of hygienic deficiencies. The most frequently observed deviation was elevated levels of storage mould (*Penicillium* spp.), which were detected in 10 of the 13 samples. The results indicate that challenges related to the hygienic quality of stored lichen may occur under current storage practices.

However, high levels of indicator organisms, such as storage moulds, do not necessarily equate to negative effects on reindeer health. Rather, they signal an increased risk that microorganisms with the potential to negatively affect animal health may be present. The findings highlight the need for focus on storage conditions, an improved understanding of the link between lichen hygiene and reindeer health, and targeted education to support reindeer herders in proper storage practices and early detection of compromised feed quality.

Perspectives of the deer ked infestation on reindeer in Finland

Kynkäänniemi, Sanna-Mari[1,2]
[1]History, Culture and Communication Studies, University of Oulu, Finland; [2]Ecology and Genetics Research Unit, University of Oulu, Finland

The deer ked (*Lipoptena cervi*) occurs in the reindeer herding area in Finland. The aim of this research was to examine the potential effects of deer ked parasitism on reindeer welfare and to investigate the emerging relationship between this ectoparasite and a new potential host species. Data for the study were collected through experimental infestation, field observations, and a questionnaire survey. Deer ked infestation causes restless behaviour for reindeer. As a result of this behaviour, hair loss can occur. The research also showed that the deer ked can reproduce on reindeer over winter. However, the number of deer ked infested reindeer can vary even inside the reindeer herding districts. Current research would be needed to follow the relationship between the deer ked and reindeer.

Insect relief for reindeer – research plan

Sauvala, Mikaela[1]; Mattila, Niina[2]; Laaksonen, Sauli[1]; Hänninen, Laura[1]; Fredriksson-Ahomaa, Maria[1]
[1]University of Helsinki, Finland; [2]Lapland University of Applied Sciences, Finland

Reindeer face multiple challenges due to global warming. Hot summers and the peak of flying blood-sucking insects cause significant stress for reindeer. These insects cause blood loss and behavioural changes in reindeer and are vectors for multiple filarioid parasites like *Setaria tundra*, *Rumenfilaria andersoni* and *Onchocerca* spp., that weaken the welfare of reindeers and cause disease. Reindeer herders have reported reindeer mortality during the hot summers and a decline in slaughter weights of calves and poor, soft meat quality. These together cause severe financial losses. Also, due to poor meat quality the meat is unsuitable for many products. Our research plan is to test the effect of deltamethrin pour on solution for reindeer against insect harassment during summer. Deltamethrin may provide relief from flying blood-sucking insects, thereby improving reindeer welfare during hot summers. We aim to test the effect of deltamethrin on reindeer and the quality of meat. We will evaluate the effects of deltamethrin on 1) the activity of reindeer during the summer and 2) the meat quality of slaughtered calves.

Photo: Dan Tjell

Wednesday 11th February

Session 3: Reindeer Health

Reindeer healthcare

Laaksonen, Sauli[1]
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Healthcare is maintaining and improving the health of the herd to improve well-being and the financial output. It includes both preventing and medical actions and lays the foundation to fulfil the legislation and to reduce and enforce the drug use and the promotion of the animal welfare. The basics of healthcare include freedom from thirst, hunger and malnutrition, the provision of appropriate comfort and shelter, the prevention or rapid diagnosis and treatment of injury or disease, freedom from distress and the ability to display normal patterns of behavior. Why: To face the increased requirements concerning the safety, ethical quality, animal welfare and the relationships to the nature. The increased mobility of people, animals and feeds promotes the transmission of (new) diseases and foreign matter. The changes in farming, the increased supplement feeding and corralling, chances in pastures, handling routines and climate expose reindeer to new health hazards. More research about the diseases and parasites of reindeer are needed. The strategy of health care includes continual monitoring of the health and productivity and the use of appropriate diagnostics, prevention of infective diseases / zoonoses, parasite control, condition optimizing, feeding and water, basic clinical health care and breeding. In the work must consider the history and culture of reindeer herding.

Remote Digital Necropsies (RDN) of reindeer in Finland

Itkonen, Laura[1]; Korkea-aho, Tiina[1]; Nylund, Minna[1]; Huttunen, Minttu[2]; Oksanen, Antti[1]; Sukura, Antti[2]; Nordgren, Heli[2]
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[2]Faculty of Veterinary Medicine, University of Helsinki

The causes of death in Finnish reindeer often remain unknown as necropsy facilities are too far away. The project "PORAUS - Remote digital necropsy (RDN) of reindeer" aims to get more data on causes of death in reindeer and provide better availability of post-mortem diagnostics for reindeer owners. On-site necropsies were performed by a local veterinarian with training for reindeer pathology. Most RDN's were conducted with real-time video (RTV) assistance. Laboratory samples (e.g. histology and microbiology) were taken based on reindeer's age, background information, and pathological findings. Veterinary pathologists examined the samples and determined the final diagnosis. Necropsies with and without RTV assistance were compared. A total of 52 on-site necropsies were performed. Of these, 28 necropsies were performed under RTV assistance and a final diagnosis was reached in 27 (96 %) cases. Twenty-four necropsies were performed without RTV assistance and a final diagnosis was reached in 20 (83 %) cases. Amount of reindeer post-mortem examinations in Finland increased substantially since the start of the RDN availability. RDN method provided more information on causes of death in Finnish reindeer. RTV assistance was found useful, as it provided more detailed information on the cause of death than necropsies performed without RTV.

Efficacy of subcutaneous ivermectin against gastrointestinal parasites in Fennoscandian reindeer

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[1]Istituto Zooprofilattico Sperimentale del Piemonte, Italy; [2]Statens Serum Institute, Denmark; [3]Finnish Food Authority, Finland;
[4] Natural Resources Institute Finland, Finland, [5]University of Helsinki, Finland

Gastrointestinal nematodes threaten ruminant health and productivity. Long-term ivermectin use in Fennoscandian reindeer raises concerns about anthelmintic resistance. This study evaluated ivermectin efficacy over time, assessing parasite prevalence, fecal egg count reduction (FECR), and effects on weight. Fecal samples from 131 reindeer, of which 66 were ivermectin treated with 10 mg/ml ivermectin formulation injected subcutaneously at ~200 µg/kg body weight, and 61 in the control group, were collected at four sampling rounds between 2016–2017. A faecal egg reduction test (FECRT) was

performed with statistical modeling to assess resistance development and impacts on parasite burden and weight. Overall, ivermectin treatment did not significantly affect *Capillaria* and strongylid egg counts in the long term, nor did it influence the weight of adult female reindeer. Fifteen days post-treatment, ivermectin significantly reduced gastrointestinal nematode prevalence and overall egg burden, particularly *Capillaria* and strongylids, while showing no efficacy against *Nematodirus*, suggesting possible resistance. However, this effect was transient. At four and six months post-treatment, efficacy was completely lost, with fecal egg counts returning to or exceeding pre-treatment levels, especially for strongylids. These findings indicate that the long-term benefits of indiscriminate annual ivermectin treatment against gastrointestinal nematodes in reindeer are questionable.

Ivermectin treatment failure of gastrointestinal parasite infections in fenced reindeer

Halvarsson, Peter [1]; Nymo, Ingebjørg H.[2,3,4]
[1]Swedish University of Agricultural Sciences, Sweden; [2]Norwegian Veterinary Institute, Norway; [3]UiT The Arctic University of Norway, Norway; [4]The Norwegian Reindeer Health Advisory Service, Norway

Reindeer herders are routinely treating their reindeer with ivermectin to reduce the impact of reindeer bot flies on animal health and welfare. Although the treatment is not aimed at their gastrointestinal parasites, ivermectin is also effective against them. A rising number of studies report treatment failures and resistance problematics in various livestock and pet species. Herein, we are conducting a pilot study of ivermectin efficacy against gastrointestinal parasites in fenced reindeer calves. Fecal samples are gathered at the time of ivemectin administration and resampled two weeks later to investigate the treatment effect. Parasite eggs are counted using McMaster. *Capillaria* eggs were found in all animals (n=22) and *Strongylide* (n=20, ΔEPG 34.3) prior to treatment. After treatment, *Strongylidae* egg was found in 13 animals, ΔEPG 9.5, a 72% reduction. Additional findings are low intensities of *Trichuris* and *Nematodirus* eggs, and fecal egg counts show variance in *Monezia* abundance between samplings. Keeping animals in high densities is a key factor for parasite transmission, and increased parasite load and resistance is favored by an inadequate ivermectin dose. Plausible explanations are i) treatment failure, or ii) anthelmintic resistance. The underlying reason needs more investigation.

Giardia and *Cryptosporidium* in reindeer (*Rangifer tarandus*) calves

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Reindeer herding in Scandinavia faces significant calf mortality, yet the underlying causes remain poorly documented. The EQUIP project ("Is reindeer herding prepared for the perfect storm?") investigates calf survival from calf marking to winter slaughter in three reindeer herding communities (RHC) in Jämtland (RHC1 and 2) and Norrbotten (RHC3) in Sweden with land-use challenges, predator pressure, and diverse climate and management practices. Calves are GPS-tagged, weighed, and sampled at two time points (calf marking in June/July and during autumn/winter). Faecal samples collected during calf marking were processed for detection of protozoan parasites using fluorescent microscopy and PCR. We detected a high occurrence of *Giardia* and *Cryptosporidium* in young calves, with striking differences between the RHCs. In RHC1, the prevalence was 51% for *Giardia* and 15% for *Cryptosporidium* (n=75), while RHC2 had 29% and 0% (n=59), and RHC3 showed 16% and 2% (n=68). These marked differences between RHCs—despite geographic proximity in some cases—are striking and may reflect underlying environmental, management, or biological factors. Both parasites can impair nutrient absorption and growth and pose zoonotic risks. Planned longitudinal analyses will assess whether early infections influence growth and survival and explore links to environmental and management factors.

Re-emergence of *Setaria tundra* in Finnmark, Norway, after nearly half a century with no detection

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Climate change, along with climate sensitive infections, impact the health and welfare of reindeer throughout Sápmi. The mosquito-borne cervid peritoneal worm, *Setaria tundra*, is increasingly a problem in reindeer in Finland and northern Sweden. This parasite has, however, not been recorded in Norwegian herds since the 1970's. In November 2025, during *post-mortem* control at the slaughterhouse, pathological liver changes in the form of mild to severe perihepatitis were noted in a large proportion of adult reindeer and calves from herding

districts across eastern and western Finnmark, Norway. In addition to this, motile, white, 5-6 cm long nematodes were seen within the peritoneal cavity, as well as multifocal to coalescing peritonitis. The nematodes were later identified as belonging to the species *Setaria tundra* and *S. tundra* microfilaria were detected in one blood sample. The perihepatitis and peritonitis was consistent with a diagnosis of setariosis. Two unusually warm summers, combined with possible earlier under reporting, led to an apparent sudden re-emergence across a wide area, with liver condemnation rates of up to 40% in some herds. This re-emergence is a clear indication that the climate, and as a result climate sensitive infections, are impacting reindeer health and welfare to an even greater extent than before.

ReMoST-ABM: Reindeer-Mosquito-Setaria-Tundra Agent Based Model

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Setaria tundra, a filarioid parasite that largely infects cervids, now causes recurrent and severe outbreaks in semi-domesticated reindeer (*Rangifer tarandus*) across northern Fennoscandia. Despite high annual treatment rates, outbreaks have expanded, impacting the herding economy through viscera/organ, and sometimes, whole-body carcass condemnation during slaughter. The links between outbreaks and warming temperature, parasite development, and vector dynamics are poorly understood. To address this gap, we developed ReMoST-ABM, a spatially explicit multi-agent-based model that simulates the transmission system by modeling the life cycle and behaviors of both reindeer and the mosquito vector (*Aedes vexans*). This model is a virtual laboratory that assesses the impact of anthropogenic factors, specifically the continuation/cancellation of summer roundups in traditional herding calendars as well as on disease outbreaks and prevalence. Simulations indicate that reindeer population and cumulative mosquito bite counts are negatively related to a small number of round-up areas, whereas mean nematode count in reindeer and total mosquito population was positively related to a larger number of round-up areas, and this appears to be true when the total reindeer population is held constant. Together, these results demonstrate the utility of an ABM for disentangling management-driven and climate-sensitive mechanisms underlying *S. tundra* transmission in a complex pastoral system.

Worms on the brain: modelling climate impacts on brainworm (*Elaphostrongylus rangiferi*) transmission risk in norwegian reindeer herds (*Rangifer tarandus* ssp.).

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Reindeer face multiple threats from the changing climate, including from parasitic disease. *Elaphostrongylus rangiferi* is a protostrongylid nematode which causes neurological disease in reindeer. Sporadic outbreaks occurring in reindeer across Norway have been associated with climatic conditions, and the thermal suitability for development of the larvae has increased over the past decades. This study aimed to determine the effect of climate change on *E. rangiferi* transmission. Species distribution models (SDMs) were developed for a range of potential intermediate host species to determine areas of the reindeer ranges with high potential for transmission. Both the SDMs and a degree-day model representing development of larvae within intermediate hosts were applied to climate change scenarios to determine potential future transmission risk. The areas of reindeer habitat suitable for gastropod hosts are predicted to expand under all climate change scenarios, potentially leading to risk of transmission in new areas. Thermal suitability is also predicted to increase, allowing a shift from the currently predominant 2-year lifecycle, to a 1-year lifecycle across the entire reindeer range. This increased rate of development is expected to result in increased transmission risk to the semi-domesticated and wild reindeer, and co-grazing small ruminants, potentially affecting the livelihoods of Sami herders.

Photo: Ingebjørg H. Nymo

Session 4: Reindeer Resilience

Resilience of Norwegian wild reindeer – thoughts from a wildlife veterinarian

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Resilience has become a frequently used term in management and societal thinking in a wide range of fields. In contrast to *resistance*, which may be defined as the ability to withstand change under pressure, resilience may, in a biological context, be defined as the capacity of a biological system to recover or sustain function following change. A highly resilient population will therefore maintain its characteristic functions, or recover to a functioning state, after a period of disturbance. Resilience of reindeer operates at several levels: (1) The individual animals' ability to handle change through physiological responses and behavior; (2) the populations' ability to compensate for adverse effects through demographic responses, changes in area use and/or genetic adaptations; and (3) the environment's capacity to provide opportunities that enable coping with new conditions. Currently, multiple factors challenge the resilience of wild reindeer in Norway, among them deteriorating population and ecosystem health. Many of these pressures are related to human overexploitation in one way or another. Consequently, we must recognize our obligation and seize the opportunities to ensure that the living conditions wild reindeer improve or, at the very least, do not deteriorate further.

Strengthening crisis preparedness and resilience in Sámi reindeer herding communities

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Reindeer herding is less vulnerable to short-term disruptions and less reliant on technical systems than other forms of livestock production. At the same time, prolonged crises and armed conflict may lead to shortages of supplies and services necessary for herding. Global security conditions are changing, and reindeer herders express growing concern about preparedness for crises such as war and major natural disasters. As food producers in areas with limited alternative food production, reindeer husbandry plays an important role in food security and total defence. Reindeer herding is already affected by various challenges. Some disruptions mainly result in increased workload and practical difficulties, while others are harder to anticipate and may have serious long-lasting consequences. Planning how reindeer herding can be maintained during crises is therefore essential for building resilience and enabling recovery. This is crucial both for continued herding practices and for the survival of Sámi culture. This work, carried out by Sámiid Riikkasearvi, focuses on strengthening preparedness within reindeer herding communities by identifying risks, vulnerabilities, and resource needs, and by developing practical strategies for both acute crisis management and long-term recovery. Strengthened preparedness can reduce losses, safeguard animal welfare, and support the continuity of reindeer herding and Sámi livelihoods.

Establishing a centre for veterinary disaster medicine – safeguarding animal health, welfare and food security

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Animals play an important role in society in times of both peace and crisis/war. Production animals are an essential resource for Sweden's food supply, and their health is central to maintaining productivity. The reindeer is of particular importance for food production, especially in northern Sweden, and represents a culturally, economically, and socially significant livelihood. Incidents involving large numbers of injured animals are complex and present significant challenges and, in such situations, expertise in veterinary disaster management is crucial to reduce suffering, safeguard food security, and support other vital societal functions. Within the framework of a three-year project funded by the Swedish Civil Defence and Resilience Agency we aim to establish the Centre for Veterinary Disaster Medicine (CVK). The centre will provide expert knowledge to ensure that animal health and welfare are considered during crises. Examples include climate-related disasters, incidents involving the release of chemical, biological, or radio nuclear agents, and other events requiring mass casualty management or large-scale animal evacuations. The centre will also contribute to training activities. Responsibility for the future CVK will be shared between the Swedish Veterinary Agency (SVA) and the Swedish University of Agricultural Sciences (SLU), with several other authorities and organisations participating in the project.

Seasonal gene expression profiling of domestic reindeer (*Rangifer tarandus tarandus*)

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Reindeer have adapted to harsh northern environments characterized by long winters, short summers, and extreme seasonal changes in daylight. Genes involved in vitamin D metabolism, retinal development, circadian rhythm, immunity, cold tolerance, and antler growth are likely critical for this adaptation. In this study, we investigated gene expressions in five reindeer from the Kutuharju experimental flock (Kaamanen, Finland) across four seasonal time points: June, November, January, and March. Blood samples were collected using PAXgene® tubes, RNA was sequenced on the Illumina HiSeq 4000 platform, and differential expression analysis was performed. We identified 1,270 genes with significant seasonal variation, including 369 with strong statistical significance and high expression levels. These genes were associated with stress response (*HSPA2*, *ARRDC4*), erythropoiesis (*ALAS2*, *RNASE4*, *RHEX*), immune signaling (*CCR1*, *CSF2RB*, *C5AR1*), and metabolic regulation (*SLC2A1*, *PTGS1*, *ENO1*). Winter vs summer seasonal contrasts revealed upregulation of genes linked to erythropoiesis, oxygen transport, lipid metabolism, and cellular stress during winter. Our findings provide insights into transcriptional mechanisms underlying seasonal adaptation in domestic reindeer.

How to adapt to multiple stressors in reindeer husbandry?

Skarin, Anna[1]; Adler, Sven[1]; Davidson, Rebecca[2]; Halvarsson, Peter[1]; Holand, Øystein[3]; Kaddik, Anna-Marja[4]; Nymo, Ingebjørg[2]; Rönnegård, Lars[1]; Sandström, Per[1]; Océane Seu, Manon [5]; Strömgren, My[1]; Tryland, Morten[5]; Qvarnström, Anna[6]

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Today, Sámi reindeer husbandry is severely impacted by both the climate crisis—through increasingly unpredictable environmental conditions—and expanding competing land use, which reduces available pastures and increases disturbance to reindeer. Reindeer numbers in Sweden have fluctuated over time; however, since the millennium winter herd sizes have remained relatively stable until the pasture crisis of 2019/2020, when a severe winter followed by a late and cold spring caused high mortality among reindeer calves. Since then, reindeer numbers have continued to decline, accompanied by reports from individual herding communities of substantial calf losses. Although successful predator conservation has contributed to increased losses due to predation, these losses cannot be fully explained by predation alone. Increased disturbance and pasture degradation reduce body condition and may increase susceptibility to infectious diseases, including climate-sensitive pathogens. In the EQUIP project, we investigate whether maintaining good body condition, demographic stability, and genetic variability can enhance reindeer populations' ability to adapt to environmental change and disease pressure. Addressing the climate crisis requires a systems perspective combined with detailed monitoring of individual reindeer within the geographical and social context of reindeer husbandry.

Photo: Ingebjørg H. Nymo

Thursday 12th February

Session 5: Reindeer Resilience

Counting reindeer using drones and artificial intelligence

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Drones are an important tool in reindeer husbandry to find, herd and move reindeer. Herders have increasingly requested tools to count reindeer in drone footage. An interdisciplinary team of researchers from NIBIO and NORCE, drone company Biodrone and Sámi reindeer herders we have developed a method to count reindeer with the help of drones and artificial intelligence (AI). A flight altitude of 40 – 120 m above ground with a camera angle between 45-90° gave best results. An AI model has been trained to recognize and count reindeer. Reindeer are difficult to recognize for algorithms as they change their appearance throughout the year (antlers, body score), display great variety in colouring and move against a varied backdrop of nature types (snow, ice, wetlands, gravel, rock, vegetation of varying colour and height). The AI model has a precision of around 90 % on both snow covered and bare ground in open vegetation and will make counting reindeer significantly more efficient in terms of time, work load, safety and finances.

Documenting animal losses with the help of drones

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All reindeer herding districts experience animal losses, yet documenting cadavers and the cause of death is difficult in the large and often inaccessible areas. Even when GPS signals indicate to the owner that an animal has died, the workload involved to travel to and find the cadaver is outweighed by the low probability of a precise enough GPS position and the high probability of the cadaver being eaten or carried away by predators and carrion eaters. Drones have given traditional reindeer husbandry a new perspective – the aerial one. In a 4 km^2 area of open and closed vegetation with grazing sheep and reindeer and documented losses to wolverine we could demonstrate that drones are very effective at finding carcasses. While the Norwegian cadaver dogs' standard expects 32 search hours and a 25 % success rate for an area this size, beyond visual line of sight drone operations in combination with known GPS position had a success rate > 90 % and required under 5 minutes per cadaver.

Development in reindeer husbandry – bottom-up approach

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Reindeer herding faces increasing challenges from unpredictable snow conditions and frozen pastures, which have led to greater reliance on supplementary feeding. While these pressures raise questions about sustainability and efficiency, the most valuable insights often come from within the livelihood itself. Local, tacit knowledge is key to practical solutions that support animal welfare and economic viability. Development projects at Lapland University of Applied Sciences focus on gathering this knowledge and sharing it widely across the field. By strengthening communication and collaboration, these initiatives help ensure that herders' experience drives future practices and decision-making. Bottom-up approaches are essential for addressing both environmental expectations and the everyday realities of reindeer husbandry.

Fine-scale movement of reindeer (*Rangifer tarandus t.*) Calves in summer in forest and alpine habitats

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The EQUIP-project is investigating reindeer (*Rangifer tarandus*) calf mortality in three reindeer herding communities in Sweden. An important part of the project is to follow calves' movement and behaviour. We have equipped calves with GPS-collars from calf marking in early summer through autumn slaughter and winter gatherings. During a two-week period in July 2024, calf positions were recorded at five-minute intervals in two of the three herding communities. In total, 300 calves were part of the study, 150 in each community. The high-resolution tracking enables fine-scale movement and habitat selection analyses in relation to external environmental factors such as weather conditions and insect harassment. The data also allow detailed investigation of diurnal activity, social interactions, and synchronization among calves. Furthermore, factors such as weight or sexual dimorphism are of interest in relation to the fine-scale movement and habitat use. This is a first step towards increasing the understanding of reindeer calf behaviour in relation to external factors in these areas. The knowledge can be useful to further investigate reasons for calf mortality within the project.

Optimizing herd structure and calf weights to mitigate effects of climate change

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The use of individual ear tags facilitates the possibilities to gain control of the age structure in a reindeer herd. Herders applying individual ear tags often also keep calves in the winter herd based on calf weights. By optimizing the herd structure and selecting the heaviest calves to the winter herd, the herd will consist of heavier animals and less variation within age classes. The aim of this study was to investigate the possibilities to mitigate effects of climate change on production in a reindeer herd. In a first attempt I have created a simulation model where body mass depends on the number of days with heat waves during a summer, and both survival and reproduction depends on body mass. The results show that the advantage of culling small calves at slaughter increases, compared to random culling of calves, as the number of days with heat waves increases. Assuming prime-aged mothers to be more resilient to heat stress compared to younger mothers, optimizing herd structure may be a possibility to mitigate negative effects of climate change on production.

Defining and evaluating "grazing peace" of reindeer in relation to disturbances (REINPEACE)

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Arctic and subarctic regions are extensively affected by climate change together with increased competing land use. Sámi reindeer husbandry is based on reindeer's ability to utilize the pastures. To optimally utilize these pastures, reindeer require undisturbed lands for searching, grazing and rumination. Reindeer herders often refer to this as "grazing peace". The aim of this project is to gain knowledge of reindeer behaviour to assess their foraging success and grazing peace in relation to human encroachments. In collaboration with reindeer herders, we will define how grazing peace, and lack of grazing peace, is manifested in reindeer behaviour. Using the qualitative results as a basis, I will quantify the effects of disturbances on behaviour by using GPS and accelerometer data from 30 reindeer (2026–2029) and previously collected data from 60 reindeer (2020–2022). Habitat selection studies based solely on GPS data do not capture underlying animal behaviour, which may lead to underestimation of important pastures. I will develop a methodology integrating reindeer's fine-scale grazing behaviour with habitat selection to find out how much, and where, the reindeer graze, and to identify periods of grazing peace. This approach will enable evaluation of grazing peace in relation to human disturbances.

Photoreception in a polar cervid (*Rangifer tarandus tarandus*)

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Due to their northern distribution, reindeer are one of the few ruminant species to experience the extreme visual environment of the Arctic circle: During Polar Day there is constant daylight, while in Polar Night the daily spectral composition is dominated by shorter wavelengths. While reindeer display seasonal physiological adaptation to the Arctic in some aspects (thermal insulation, digestion and foot morphology), little is known about their visual adaptations. An organism's visual performance is tightly linked to their ability to perform ecological tasks such as foraging, predator detection and social interactions. Based on the observation that reindeer seasonally alter the molecular structure of their tapetum lucidum to reflect green-yellow light in Summer and blue-violet in Winter, it has been speculated that they may be also altering the spectral sensitivity of their opsins. In this study, we combine molecular and physiological approaches to characterise photosensitive opsin proteins in reindeer (*Rangifer tarandus tarandus*). We

will characterise the λmax of reindeer visual pigments using in-vitro opsin expression and spectral analysis. These λmax estimates will then be linked to photo-neuroendocrine function by assessing wavelength-specific influence on melatonin secretion inhibition in living animals. Comparative sequence analysis will also be used to investigate the presence of spectral tuning and selection on reindeer opsin proteins.

Photo: Lotta Berg

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