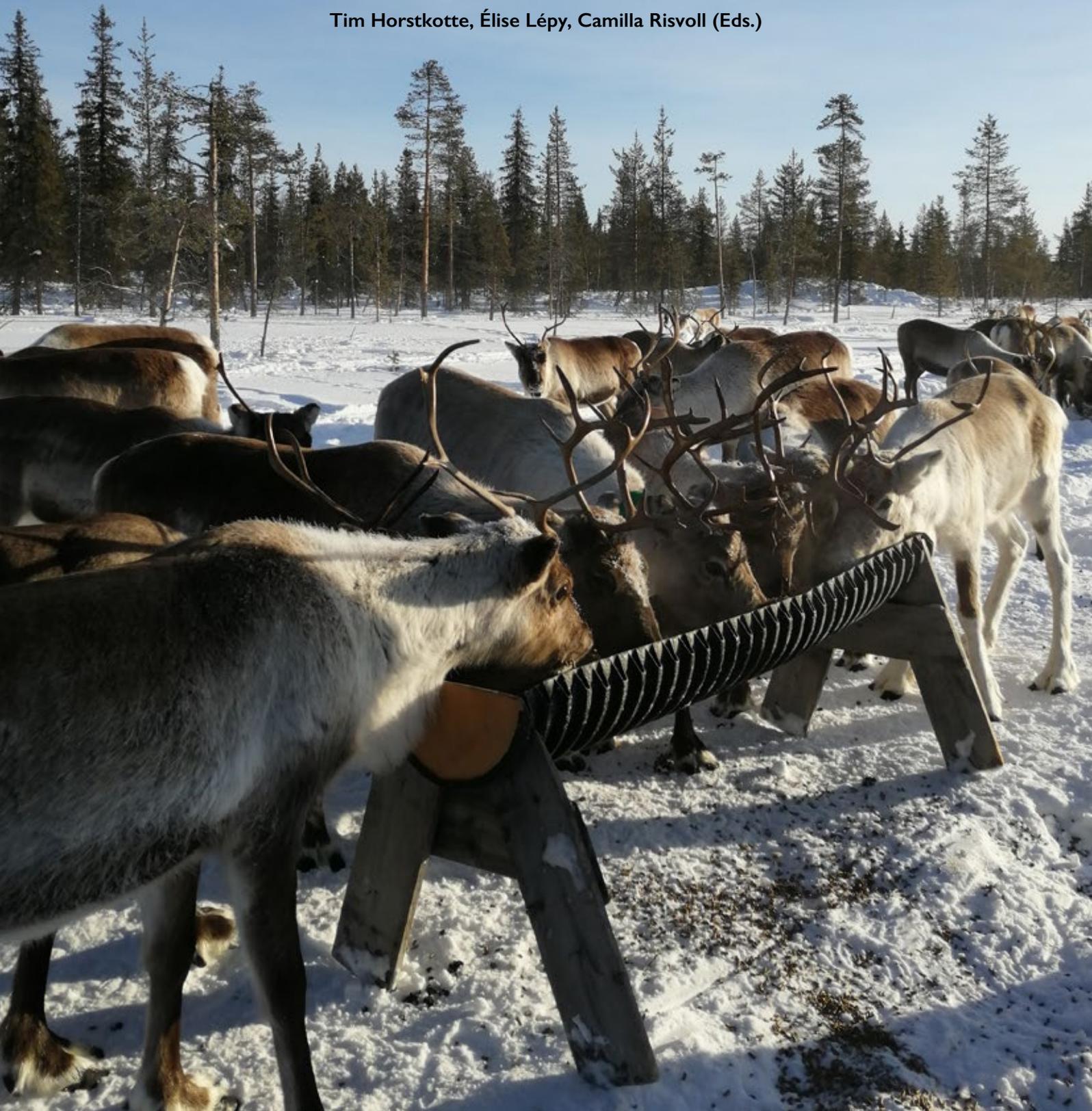


SUPPLEMENTARY FEEDING IN REINDEER HUSBANDRY

Results from a workshop with reindeer herders and
researchers from Norway, Sweden and Finland

Tim Horstkotte, Élise Lépy, Camilla Risvoll (Eds.)



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Preface

Spring 2020. A difficult winter - with recurrent frost and thaw cycles leading to ice crusts and little snow in some places, contrasting with extremely deep snow in the mountains and northerly parts of Fennoscandia - is now giving way to a cold spring with delayed snow melt during calving. Providing reindeer with supplementary feeding has therefore become a widely spread necessity during these past months in almost the whole reindeer husbandry area in Fennoscandia.

Supplementary feeding can be seen as one consequence of the accelerating effects of climate and environmental change. It is also an aftermath of the increasing development of resource extraction. All are profoundly altering the prerequisites for reindeer husbandry. The diversity of these effects is reflected in the diversity of reindeer husbandry itself - including its historical, biogeographical and cultural dimensions.

It is precisely this diversity that offers the opportunity of learning from each other to respond to ongoing changes: where different experiences, know-how and knowledge types can be combined, they may help to find solutions and develop a more robust, holistic understanding of present and future challenges. This report originates from such an exchange of knowledge of and experiences with supplementary feeding, in Kiruna in 2018, between reindeer herders from very different areas of the reindeer husbandry area of Fennoscandia. The results presented here rest upon the participating herders' experiences, knowledge and insights, and their active involvement in the writing process. We hope that this collaborative work - amongst herders, and between herders and researchers - does justice to the manifold complexities involved in supplementary feeding.

We believe that future collaborations for rewarding exchange and co-production of knowledge will emerge: across borders, practices, languages and types of knowledge - including experience-based knowledge and scientific knowledge - to prepare for the changes affecting almost every aspect of reindeer husbandry.

We are indebted to all participating reindeer herders and researchers for their commitment and willingness to share their knowledge and experiences. The workshop would not have been possible without the skilful interpretation between the involved languages by Michelle Francett-Hermes.

We are also grateful for the funding that was received for this workshop from NordForsk under the Nordic Council of Ministers, ARCUM and CIRC at Umeå University (Sweden), the program for "Future Animals, Nature and Health" at the Swedish University of Agricultural Sciences (SLU), Nordland County Municipality (Norway) and the Nordic Centres of Excellence CLINF (Climate change effects on the epidemiology of infectious diseases and the impacts on northern societies), ReiGN (Reindeer Husbandry in a Globalizing North) and REXSAC (Resource Extraction and Sustainable Arctic Communities) financed by NordForsk. Some of the received funding was used to compensate participants for their time investment, travelling and subsistence expenses for the workshop.

May 2020

Tim Horstkotte, Élise Lépy & Camilla Risvoll

Contents

1. Why this workshop?	6
1.1 What is supplementary feeding?	6
1.2 Approach	9
2. A high degree of variation exists within and between countries	12
3. Financial support by governments for supplementary feeding	13
4. Structure of the report	14
5. Principal concerns	15
5.1 Reindeer feeding on natural pastures is the preferred option	15
5.2 Weather and climate affect the need to feed	15
5.3 Predators affect supplementary feeding practices	16
5.4 Other land users and institutional regulations affect the need to feed	16
5.5 Supplementary feeding involves economic trade-offs	17
5.6 Supplementary feeding may affect reindeer health	18
5.7 Supplementary feeding may affect reindeer behavior	19
5.8 Supplementary feeding may threaten traditional and experience-based knowledge and culture	19
5.9 Supplementary feeding may weaken rights to grazing lands	20
5.10 Supplementary feeding affects vegetation and soils	20
5.11 A risk of supplementary feeding affecting public acceptance	20
6. Practical experiences	24
6.1 Individualization of herding livelihood and erosion of communities and social practices	24
6.2 Supplementary feeding changes reindeer behavior	25
6.3 Predators can influence decision making and practices in supplementary feeding	25
6.4 Reindeer health and well-being need attention before, during and after feeding	26
6.5 Economic trade-offs are involved in supplementary feeding	27
6.6 Type and quality of feed require particular attention	27
7. Knowledge gaps	29
8. Way Forward	30
Epilogue: Final reflections by workshop organizers	31
Appendix: Reindeer Husbandry in the three countries - an overview	32

Highlights from the workshop

- Supplementary feeding is a response to difficult grazing conditions and other forms of land use.
- Supplementary feeding is **not considered a long-term solution** to resolve crises with regard to inaccessible grazing resources.
- Supplementary feeding is **avoided as long as possible**, but the need to start feeding before starvation and emaciation in order to allow reindeer to adapt to the feed is recognized.
- **Practices and reasons for supplementary feeding** vary within and between the reindeer husbandry areas in Norway, Finland and Sweden.
- Principal reasons for supplementary feeding can be **difficult grazing conditions** during winter due to ice layers and/or deep snow, presence of **carnivores, competition with other forms of land use** or **lack of grazing resources** resulting from these competitions.
- Implementation of supplementary feeding **requires specific knowledge** and skills.
- **Knowledge exchange** about supplementary feeding between herders is necessary and helpful to learn from each other.
- Increased necessity of supplementary feeding may threaten reindeer husbandry **traditions and culture**, as well as the intergenerational **transfer of experience-based knowledge**.
- **Thriving reindeer** is the most important aspiration for reindeer herders. **Advantages** of supplementary feeding include increased reindeer **survival**, better **control of the herds** and **reduced losses to predators**.
- **Major challenges** with feeding are increased **disease risks** associated with feeding and transmission of infectious or spreading diseases, changes in reindeer **behavior** as well as the **financial burden** and workload.
- **Increased knowledge** about quality requirements in supplementary food for reindeer is needed.



1. Why this workshop?

This report is based on a collaborative workshop that was organized by researchers from three Nordic Centres of Excellence related to Arctic sustainability. The coordinating lead authors, Tim Horstkotte, Élise Lépy and Camilla Risvoll, were the main organizers for the event taking place in Kiruna, Sweden, during 22nd - 23rd March, 2018. The workshop developed as a response to the concerns raised by reindeer herders on the increased need to buffer catastrophic grazing conditions with supplementary feeding in Norway, Finland and Sweden during the past decades. Grazing conditions have become increasingly difficult in the past decades due to both difficult weather conditions and a more general loss of or access to grazing areas and 'grazing peace'. Reindeer herders' experiences with supplementary feeding vary considerably between and within the countries, particularly with regard to practice, objectives and intensity. This report shares the stories and experiences of the herders who participated in the workshop and reflects the realities in the reindeer herding areas where they are active. Whilst we are interested in highlighting both differences and similarities between the herders and their experiences, issues of representation and generalisation are notoriously difficult. Thus, the results presented here are not necessarily generalizable to other reindeer herders.

Nevertheless, the interactions at the workshop illustrate that localized knowledge about feeding can provide important learning opportunities for other herders. As one herder expressed:

 *To meet means to learn. Especially young people have different experiences than older people have.*

Above all, this workshop created an arena for participants from the three countries to:

- initiate a cross-country dialogue on supplementary feeding.
- share their experiences, knowledge and perspectives.
- initiate critical discussion between herders and researchers in the field on challenges and opportunities.

This report summarizes the major topics that emerged during the workshop. We wish to reach out principally to the reindeer herding community in each country, but also to government authorities, representatives of other forms of land use in Norway, Sweden and Finland, as well as others with an interest in the complexities inherent in supplementary feeding of reindeer.

1.1 What is supplementary feeding?

Supplementary feeding is practiced by reindeer herders when natural grazing resources are unavailable or the grazing conditions are challenging for reindeer. The practices and reasons for feeding, as well as the availability of different types of feed have changed significantly over time (Box 1).

At the workshop, we focused on supplementary feeding as a strategy to buffer the unavailability or inaccessibility of natural grazing resources for reindeer during winter, i.e. a form of emergency feeding or crisis remedy. The reasons for shortages in grazing resources are manifold, as will be demonstrated by the herders' views and experiences in this report. However, in particular, in the southern part of the Finnish reindeer husbandry area, supplementary feeding occurs much more regularly when compared to other parts of the reindeer husbandry area in Fennoscandia (Table 1.1). In this report, we use the phrase supplementary feeding as an umbrella term for both these types of feeding strategies.

Besides being a strategy to buffer lack of, or inaccessible natural grazing resources, reindeer receive additional feeding also during specific herding operations (Table 1.2). Examples include feeding of female reindeer during the calving period to protect mothers and calves from predators, or during migration between different seasonal grazing grounds to guide the herds and keep them gathered. In Sweden, feeding may also be necessary to reduce radio caesium-concentrations in live reindeer resulting from the radioactive fallout of the Chernobyl-disaster in 1986. While discussions occasionally touched upon these strategies and usages the workshop focused on the former use of supplementary feeding.

Table 1.1: Reasons for supplementary feeding described by workshop participants

Reasons for feeding	Examples from Norway	Examples from Sweden	Examples from Finland
Adverse snow and ice conditions	Common reason, increasing trend	Most common reason, increasing trend	Common reason for feeding and the main reason why feeding started in the northern reindeer husbandry area
Predators	In some herding districts, increasingly common	Limited, not the primary reason	Very common, especially in the south-eastern area
Forestry	Minor/none, as no substantial overlap between these land uses	Common, often the principal reason due to reduced availability of grazing resources	Most common reason in the southern areas, but applies in other forest pastures as well
Disturbances from infrastructure: wind farms, mining, hydropower etc.	Not so common, but increasing trend due to increased exploitation	In several herding districts, increasing trend due to increased exploitation	Common reason in many districts and increasing everywhere
Direct human disturbances	Uncommon	Common in northern areas, uncommon elsewhere	Common in districts close to tourism and outdoor recreation centres and to reduce traffic accidents with reindeer
Other reasons for feeding	To keep control of herds at specific times and movements	Keeping control over herd movements, can reduce certain types of workload, but increase others instead	To ensure high calf production, and meat production

Table 1.2: Different types of supplementary feeding

Types of feeding	Examples from Norway	Examples from Sweden	Examples from Finland
Corral feeding in winter	Only in few districts, during especially adverse grazing conditions and under restricted time periods	Only under especially adverse grazing conditions and under restricted time periods	In some areas due to predators and loss of arboreal lichen due to forestry practices
Corral feeding during calving	Very uncommon, but some have seen no other option due to predators	Occasionally, but uncommon	Common in some northern herding communities
Feeding free-ranging animals	With geographic variation in regularity and intensity	With geographic variation in regularity and intensity	With geographic variation in regularity and intensity
Feeding during the calving period and/or seasonal migration	Occasionally during restricted times and at strategic places	Occasionally during restricted times and at strategic places	With geographic variation in regularity and intensity

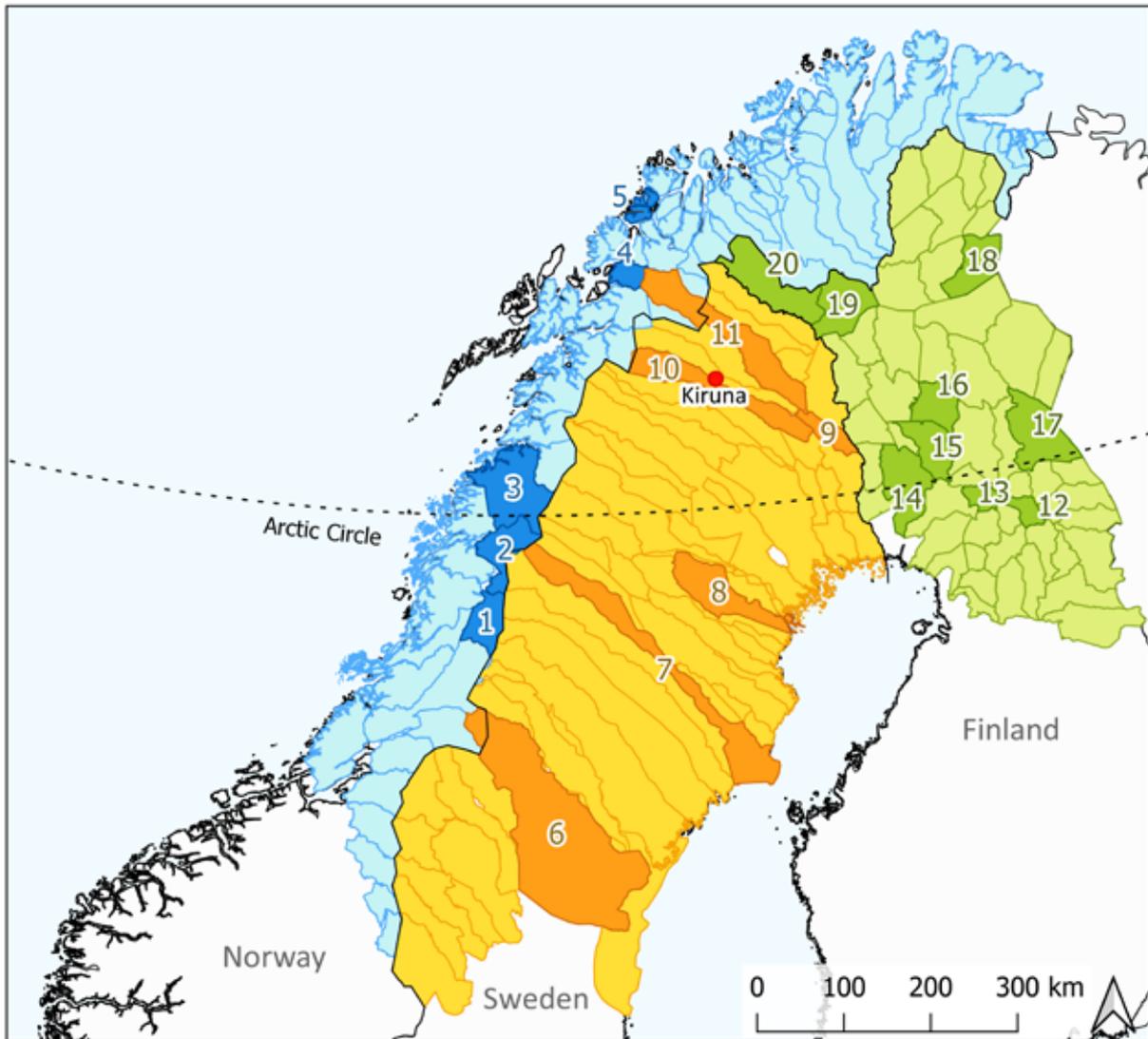


Figure 1: Districts from where reindeer herders participated

- 1.** Byrkije • **2.** Ildgruben • **3.** Saltfjellet • **4.** Hjerttind • **5.** Kvaløy • **6.** Jijnjevaerie • **7.** Ran • **8.** Östra Kikkejaure • **9.** Sattajärvi • **10.** Laevas • **11.** Saarivuoma • **12.** Posion-Livo • **13.** Niemelä • **14.** Palojärvi • **15.** Poikajärvi • **16.** Syväjärvi • **17.** Salla • **18.** Ivalo • **19.** Näkkälä • **20.** Käsivarsi

1.2 Approach

Participants

The success and results of the workshop were dependent on the reindeer herders' willingness to participate. To capture the relative broad range of practices and reasons to provide supplementary feeding between and within the different countries (see tab. 1.1 & 1.2), we aimed for a wide geographical spread of participants (fig. 1). At the same time as the workshop, herders in many districts had ongoing work with the reindeer. This prevented some representatives from participating, for instance herders from Finnmark could not participate for that reason.

Some of the invitations to reindeer herders were sent out based on earlier collaborations, established contacts as well as by snowball sampling, others by contact with reindeer herders' organizations. At the workshop, 24 reindeer herders were present (Norway: 6, Sweden: 9, Finland: 9). Depending on the participants present at the workshop, the results presented in this report reflect their local context for reindeer husbandry.

In addition to the herders, researchers with different disciplinary backgrounds, including ecology, anthropology, sociology, geography, political science and veterinary medicine participated (20 research participants). Their role was to engage in discussions with herders. The overall aim was to connect multiple knowledge systems in order to address supplementary feeding from different perspectives.

Herders' contributions

Herders' involvement included not only their active participation in the workshop, but also their engagement, and valuable input during the writing process of this final version of the report. Following the workshop, a draft summarizing the workshop results was sent to each participant. The herders' feedback and additional input were included in this final version. Material for this final version was circulated again with participants before publication, to in the best possible way reflect their views, concerns and contributions.



One reindeer herder per country presented their local feeding practices as an example. Photo: É. Lépy

Organization of the workshop

The workshop started with a presentation of an overview of the history of supplementary feeding (see box 1) and the health risks involved in such practices from a research perspective (see box 2). These were followed by presentations by reindeer herders from each country, offering examples of their ways to practice supplementary feeding.

The workshop consisted of two parts. The first day was committed to discussions about local conditions in groups divided according to the language spoken by the participants: Norwegian, Swedish and Finnish. Researchers took notes and asked questions. These discussions were summarized and presented by the herders to all participants at the end of the day.

The second day consisted of discussions and questions between all reindeer herders. Communication and exchange between herders from the different countries was the major aim of our workshop. These discussions form the backbone of the results presented in this report.

Language was an important and challenging aspect during the workshop. Due to the many languages that were spoken at the workshop, we had to find a common ground to enable the best mutual communication possible. The language barrier between Finnish and Norwegian/Swedish may be one reason why the exchange between Finnish and Norwegian/Swedish herders can be limited. During the workshop, an interpreter fluent in Swedish and Finnish was providing simultaneous interpretation, receiving broad praise for her commitment.

We are aware of and acknowledge that Sámi languages are a vital cultural keystone, and important to express and accurately describe reindeer herding activities. We did not include Sámi interpretation in the workshop for several reasons. As reindeer herders from different parts of Sápmi participated, several Sámi languages would have been involved. Unfortunately, the available budget did not allow for the hiring of interpreters for multiple languages. However, this report is available in North Sámi, with a summary in South Sámi.



Group work during Day 1. Photo: É. Lépy

Box 1: Historical trends in feeding

Reindeer husbandry in Fennoscandia is based upon the use of natural pastures as a food supply for reindeer. Nevertheless, in some winters, situations may occur when herders need to support the reindeer with supplementary feed in order to prevent starvation. Modern forestry and loss of land have reduced the availability of alternative pastures and forests with arboreal lichens, the traditional emergency food for reindeer.

An urgent interest to develop easily available supplementary feeds for reindeer appeared after some particularly harsh winters in large parts of Sápmi during the late 1960s, when that saw many reindeer starved to death. Numerous experiments with different feeds to reindeer were made e.g. at the research stations in Lødingen, Norway, and Koulpavaare, Sweden, during the 1970s. The feed mixtures that were developed at that time were further developed into the factory-made pellets for reindeer that are presently available on the market. Likewise, supplementary feeding with hay started in Finland after really bad winters in the late 1960s and early 1970s. Feeding with hay soon became a common practice in many herding districts in the southern and middle part of the reindeer herding area in Finland. Agricultural subsidies for farmers encouraged this development.

The Chernobyl accident in 1986 contaminated reindeer pastures in Sweden and Norway and increased the need for feeding and the production of factory-made reindeer feeds. Although the need for “clean feeding” has ceased, herders have continued to feed reindeer to a larger extent than before the accident.

Grass silage started to be used in reindeer herding during the 1990s, following the introduction of round-bale silage. Several research experiments were performed, e.g. testing how different qualities of silage were utilized by reindeer. There is, however, still no clear recommendation on the optimal composition of silage for how silage to reindeer should be composed and there is an ongoing debate on what is a “good” silage for reindeer should be (or if hay or silage should be used at all).

Presently, many of the large feed factories in Fennoscandia produce grain-based feeds (pellets) specifically intended for reindeer. The nutritional composition does not differ very much between the different feeds, although the ingredients may vary and there are some feeds with more protein (intended for e.g. pre-slaughter feeding) and others with more fiber (which are better as supplementary feeds and for cautious adaptation when the reindeer are not used to feeding). Some feeds contain additives intended for avoiding gastrointestinal disturbances, which are common among pellets-fed reindeer.

Supplementary feeding has continued to be a regular part of reindeer management for many herders in the southern and middle part of the Finnish reindeer herding area, although dry hay has gradually been replaced with grass silage, and factory-made reindeer pellets are also commonly used. In Sweden and Norway, as in northernmost Finland, feeding is still mainly used in winters with poor grazing conditions because of hard snow or icing, and pellets is generally the main feed. Feeding is also used during gathering and migration to facilitate herding and handling of the reindeer.

Birgitta Åhman

2. A high degree of variation exists within and between countries

Migration patterns between different seasonal grazing grounds differ between and within countries (fig. 2). Winter grazing areas are also located in different vegetation zones. These differences in practices and in the location of pastures result in different exposures to competing forms of land use, predator pressure or changing weather conditions. These differences may affect the need, frequency and intensity to provide supplementary feeding. For example, forestry operations have had a significant impact upon the natural grazing resources for reindeer in Sweden and Finland, whilst within the Norwegian reindeer husbandry area, commercial forestry is very limited. The long history of forestry in the southern part of the Finnish rein-

deer husbandry area has reduced the availability of terrestrial and arboreal lichen to such a degree, that supplementary feeding in this area has become the norm rather than the exception. It is therefore more common to keep them in corrals for longer periods in this area.

The reindeer husbandry in Norway is distinct in its high topographical variation. From inland mountain plateaus such as Finnmarksvidda in the far North of the country, the landscape changes to high mountains, deep valleys, fjords and coastlines further south.

However, in the whole reindeer husbandry area, herders are becoming increasingly burdened by crises due to difficult snow conditions that prevent access to grazing resources.

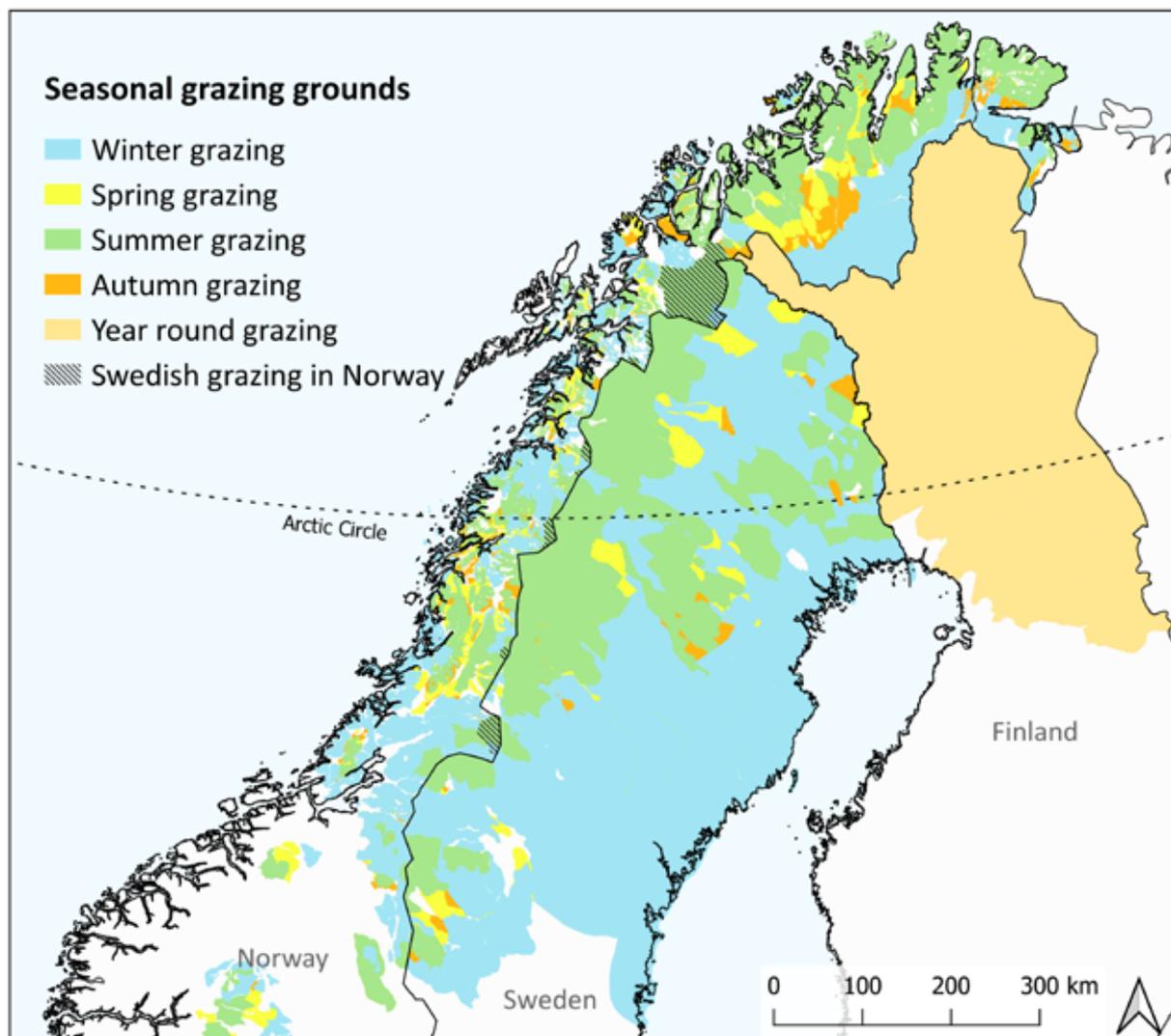


Figure 2: Seasonal grazing grounds in the respective country
In Finland, seasonal rotation between grazing grounds is practiced at smaller spatial scales, and is therefore not visible in the map.



Presentation of group discussions to all participants. Photo: É. Lépy

3. Financial support by governments for supplementary feeding

Norway

The former Norwegian/Swedish Reindeer Grazing Convention, regulating cross-border reindeer migration, ended in 2005 and the states have yet to agree on a new convention. The result of this is that some herding districts are unable to utilize the part of their traditional winter pastures which are located across the Swedish border. They are able to apply to the government for financial support to purchase supplementary feed for the herd, moreover, herders can apply for aid to implement measures to prevent losses from predators (e.g. lynx, wolverine, eagles). This funding is intended for intensified herding/tending the herd combined with supplementary feeding, and is through the funding scheme called ‘Prevention and conflict reducing measures’ (Forebyggende og konfliktreducerende tiltak - FKT) at the regional government.

Sweden

In Sweden, herding communities can apply for “catastrophe relief” to the Sámi Parliament during winters with exceptionally difficult grazing conditions; in particular due to ice-crusting snow, while recent discussion also takes deep snow into consideration. The support is stipulated in the

§35 of the Reindeer husbandry ordinance (*Rennäringsförordningen*) and regulated in provisions issued by the Sámi parliament. Recently, the definition of ‘exceptionally difficult grazing conditions’ has been adjusted from the provision to better adjust to local conditions. Catastrophe relief is meant to prevent the starvation of reindeer and is paid retrospectively and supposed to cover a maximum of 50% of the costs related to supplementary feeding. It is paid to the herding district, not to the individual reindeer herder. However, herders do not know in advance of what extent of support they can rely on.

Finland

Hay production is subsidized by the EU, but there is limitation for eligibility, depending on the size of fields. This can be problematic for many reindeer herders if their fields are too few, too small or if, for some reason, ineligible for EU subsidies. Catastrophe arrangements are considered by the Ministry of Agriculture and Forestry annually. There have been some urgent aid arrangements on several occasions since the 1990s during a period marked by frequent exceptionally hard winters and springs resulting in mass-starvation of reindeer.

4. Structure of the report

The workshop results reflect herders' experiences of navigating the complexity of supplementary feeding. Discussions on supplementary feeding are tightly connected to herders' concerns, as well as visions and empirical unknowns, regarding desirable and sustainable futures of the reindeer herding practices.

The results, compiled from participating herders during the workshop, are presented in two different, but related, sections followed by identifiable knowledge gaps.

- **Principal concerns** summarize what reindeer herders are concerned about and why this concern is of significance to their livelihoods. Considerable differences between countries are specified in the text, as generalizations across countries are not always possible.
- **Practical experiences and concerns** illustrate strategies by reindeer herders in response to these challenges. Some specific examples are given, indicating from which country these experiences originate.
- **Identified knowledge gaps** are based on discussions between participants, who raised these as uncertainties in the future application of supplementary feeding. In addition, these can be seen as an indication of future areas of collaboration between herders and researchers.

Photo: T. Horstkotte



5. Principal concerns

The key objective of all participating herders is to sustain reindeer herding as a viable livelihood in Norway, Sweden and Finland. This includes securing the survival of their herds, the well-being and health of their reindeer and longevity of culturally acceptable reindeer herding practices. These considerations form the basis for the following reflections, discussion and conclusions. The themes discussed indicate possible goal conflicts and knowledge gaps. We do not claim to provide any answers to these complex matters in this report.

5.1. Reindeer feeding on natural pastures is the preferred option

Reindeer sustaining themselves on natural grazing resources throughout the whole year would be the ideal situation for herders in all countries. The reindeers' capability to make use of the sparse resources in northern ecosystems that humans themselves cannot utilize, is considered one of the vital benefits that reindeer provide to people. However, supplementary feeding turns this dynamic around. In the words of one participating herder:

“The reindeer should feed us, not we, the reindeer.”
(Herder from Sweden)

Participating reindeer herders were clear that supplementary feeding is only resorted to when natural grazing resources are impossible to reach for the reindeer or insufficient. According to herders, supplementary feeding is mainly treating the symptoms of inaccessible or lost grazing resources, but it does not contribute to solving the original problems. Even though grazing grounds may be inaccessible, supplementary feeding is often avoided or delayed as long as possible - with the challenge of identifying the correct time to act. Sufficient time is necessary to allow the animals to adapt to the taste and the reindeers' advanced digestive system to adjust to the change in forage.

Herders affirm that sometimes there are just no other alternatives than to feed the herd. The specific reasons for feeding can differ even within the same herding district (see tables 1.1 and 1.2).

Herders shared experiences about being forced to feed due to loss of pastures as a consequence of encroachments of grazing grounds by other forms of land use, presence of predators, increased human activity (such as tourism) and pastures locked by ice crusts following freeze-thaw cycles or rain-on-snow events. This trend of increasing need to feed reindeer is by no means a preferred strategy by



Photo: T. Horstkotte

herders. Herders from all countries describe that they would prefer to rely on natural pastures rather than feeding reindeer in general. If it is necessary to feed, they prefer feeding free-ranging reindeer rather than in corrals. The challenges include increasing costs compromising profitability of reindeer husbandry. One herder noted:

“Supplementary feeding gives us several challenges and concerns...we are worried about being trapped in a system...we are urged to feed, but this has some consequences for us, for our culture and knowledge.”

(Herder from Norway)

5.2 Weather and climate affect the need to feed

One main reason behind supplementary feeding is snow cover, as it can limit access to and / or availability of grazing resources. Snow becomes an obstacle to reindeer foraging if it accumulates too deep (usually above a threshold of around 70 cm) or too hard to break by reindeer due to ice crusts on top or within the snow layer, or both. Reindeer also encounter problems in digging through wet layers of snow.

Climate change increases the frequency and intensity of freeze-thaw and rain-on-snow events. These incidents can result in ice covered pastures which in turn can hinder reindeer in accessing their natural forage throughout large parts of winter. It may also affect reindeer health because the reindeers' metabolism must provide significant energy to thaw ice-encrusted lichens.

In these circumstances, supplementary feeding becomes necessary to prevent starvation or deteriorating health. For example, in Sweden, the number of applications to catastrophe support from *Sametinget* has increased in recent years, with almost all herding communities applying for support in the winter 2017/2018.

Unfavorable grazing conditions during summer or autumn may reduce the reindeers' robustness to difficult winters due to weak body conditions and may contribute to the need to provide supplementary feeding. Weak body condition in autumn therefore could be an indicator that supplementary feeding might become necessary during the winter.

5.3 Predators affect supplementary feeding practices

Herders from all three countries reported that the threat from predators, mainly lynx, wolverines and wolves, was one of the leading reasons in pushing them to provide supplementary feeding. Feeding gives the advantage of better control and surveillance of the herd, while corrals can offer protection from carnivores. Examples from Finland show that reduced predation in some cases due to feeding in corrals helped herding communities to generate income from meat production, rather than from predator compensations, compared to the free-grazing neighboring community. Feeding spots can, however, attract predators and thus require additional surveillance. Better protection of reindeer also increases the mental well-being of herders.

Still, government authorities may support supplementary feeding in corrals rather than culling nuisance predators, which herders could see as an interference with their rights to use the grazing lands. Feeding therefore is perceived as a straightforward solution for management authorities which does not take into account the inherent complexities for reindeer herders.

5.4 Other land users and institutional regulations affect the need to feed

Forestry

Forestry has had a strong impact on reindeer husbandry in both Finland and Sweden, as forestry practices have contributed to the loss of arboreal and terrestrial lichens. For instance, in Finland, forestry has been one of the major reasons for supplementary feeding since the 1970's, except in the northernmost fell region above the economically productive tree line. Even in those areas where arboreal lichens are still present so that reindeer may survive on them, their abundances are insufficient for a sustainable economy for the herders during difficult winters.

In Sweden, the loss of these resources is felt by all herding districts. Some districts with access to mountain pastures might be able to graze their reindeer above the tree line, if snow conditions are particularly difficult in the forest. This, however, is not seen as a long-term solution, as these areas should be spared for example as spring pastures.



Photo: C. Risvold

“The fact is that there is not enough (natural) fodder, we must feed. A herder is not the only one responsible for this. The herders have to maintain the number of reindeer high, because if they don't, other land users may start using the land.”

(Herder from Finland)

Extractive industries, energy production and tourism

Other major competing land uses include mining, wind power and hydropower, but also smaller infrastructure projects, tourism and outdoor recreation activities all affect herding communities. According to some participants, one of the greatest challenges is the continuous land use by multiple smaller scale development projects that hardly receive public recognition. However, tourism can be a source of income for reindeer herders as well.

These diverse and cumulative forms of land use, dissect and fragment remaining reindeer pastures, reducing the amount of available grazing resources even further. Reindeer herders are forced to defend their land and rights day after day, year after year, in negotiations with a huge variety of interest groups. Herders have to take part in these negotiations with their own modest resources and in addition to their main occupation, which depends on the rhythms of nature and reindeer.



5.5 Supplementary feeding involves economic trade-offs

In general, reindeer herders describe supplementary feeding as expensive. Economic costs of feeding consist of buying or producing all types of feed, transportation, storage, feeding, as well as an altered time commitment.

The economy of the individual herder is an important aspect in decision making with regard to supplementary feeding, as personal economy ultimately depends on generating income from the animals. As feeding can maintain stable herd sizes, some participants identified the need to secure a stable economy as a major incentive to feed. Trade-offs in decision making therefore can be challenging, because the long-term consequences are difficult to estimate. The financial costs of supplementary feeding can develop into an insurance to secure survival and condition of the herd and prevent starvation. To reduce or stop supplementary feeding altogether, new strategies of the use of the grazing grounds would be necessary.

“*In the 60s, winter conditions were bad. Reindeer starved. Then supplementary feeding with dry hay began, but it was not sufficient. The feed was not diverse enough and reindeer died at the feeding spots. Nowadays the feed has higher quality. The amount of lichen rich forests has been decreasing and reindeer pastures have been lost due to forestry. How do you calculate the costs [for us herders]?”*

(Herder from Finland)

Compensation for lost grazing grounds

The consequences of losses of grazing grounds due to other forms of land use are difficult to estimate in financial terms. Monetary compensation to reindeer herding communities cannot fully reflect the multiple consequences of lost grazing resources, e.g. due to increased workload involved with feeding practices. Furthermore, financial compensation to reindeer herders could limit the motivation/willingness of other forms of land use or government authorities to provide alternative options for financial compensation, such as restoring grazing areas. Herders caution against reducing the value of the land to merely monetary terms, as this would ignore the cultural dimension inherent in the access to and use of the land. Therefore, reindeer herders clearly preferred and depended upon access to functional grazing grounds over solely financial compensation.

“*There is the risk of setting a price tag on a square-meter of land. We can end up in a vicious circle when feeding in corrals: if we apparently do not need the land, the reindeer can be in the corrals anyway.”*

(Herder from Sweden)

Dependency on supplementary feeding therefore seems to be directly related to the magnitude of impacts by other land users within a herding district.

Supplementary feeding is time consuming, or at least changes time commitments, workloads and practices to care for the animals. Since reindeer often stay close to feeding areas, less herd surveillance may be necessary, though this varies a lot between districts due to e.g. their topography and size. However, in some of them more work force is required to transport the feed and equipment, and to manage the distribution to the animals, and thus may leave little time for anything else. Some herders from Finland pointed to the irony that supplementary feeding in their local context can create some room and time to defend their rights and participate in negotiations with other forms of land use, often a cause that makes supplementary feeding necessary in the first place.

Supplementary feeding may also influence decision making with regard to herd composition, as the food for reindeer is no longer “free”. Keeping females beyond their reproductive prime age, for example is a practice that may become too costly. Furthermore, males do eat more than females do.

Box 2: Health aspects and diseases

Feeding reindeer may affect the health and diseases of reindeer both as a direct effect of the feeding regime and the feed, and indirectly due to factors associated with the feeding situation, such as stress, high animal density, hygienic conditions and introduction of pathogens. Diseases are contributing to poor animal welfare and economic loss for the herders.

Most feed that are used for supplementary feeding of reindeer differs substantially from natural pasture resources. Also, reindeer are used to search for and select their feed, whereas in a feeding situation, they are offered one or very few sources of nutrients and often only during a very restricted time period during the day. These differences may create certain challenges for the digestive tract of a reindeer. Accumulation of grass in the rumen, ruminal acidosis, diarrhea, bloat and wet belly are all conditions that can be directly associated with poor quality feed and/or unfavorable feeding regimes, such as sudden changes (Åhman et al., 2018).

Feeding of reindeer is usually increasing the animal density of the population and facilitating transmission of infectious agents. In addition, gathering and corralling reindeer are often associated with the release of stress hormones, which may introduce immunosuppression, making the animals more susceptible to infectious diseases and more prone to develop severe disease. If animals are gathered in corrals, unfavorable hygienic conditions may also contribute to infectious diseases. Some infectious diseases have been clearly associated with stress and feeding situations, such as necrobacillosis (*Fusobacterium necrophorum*), contagious ecthyma (parapoxvirus), transmissible eye infections (cervid alphaherpesvirus and bacterial infections) and pasteurellosis (*Pasteurella multocida*) (Josefsen et al., 2018; Tryland et al., 2018).

As an animal owner, a reindeer herder is responsible for the health and wellbeing of the animals. In a feeding situation, it is important to follow the animals closely and to have knowledge about normal and abnormal behavior and to be able to recognize early signs of disease. Veterinary service should be available and be used to identify health problems and diseases, to minimize animal suffering and costs.

Morten Tryland

References: Josefsen TD, Mørk T, Nymo IH. 2018. Bacterial infections and diseases. In: Tryland M, Kutz SJ (Eds.), Reindeer and Caribou - Health and Disease. CRC Press, Boca Raton, pp. 237-271. • Tryland M, Das Neves CG, Klein J, Mørk T, Hautaniemi M, Wensman J. 2018. Viral infections and diseases. In: Tryland M, Kutz SJ (Eds.), Reindeer and Caribou - Health and Disease. CRC Press, Boca Raton, pp. 273-303. • Åhman B, Finstad GL, Josefsen TD. 2018. Feeding and associated health problems. In: Tryland M, Kutz SJ (Eds.), Reindeer and Caribou - Health and Disease. CRC Press, Boca Raton, pp. 135-156.

5.6 Supplementary feeding may affect reindeer health

Supplementary feeding is a means to prevent starvation, and thus a means to improve condition and welfare of the animals. However, feeding also challenges reindeer health and requires particular care by the herders. Any feed given to reindeer must be of high quality and needs to be provided in regulated quantities to avoid digestive disorders. The need to start supplementary feeding in good time is well recognized. In practical terms, this means that supplementary feeding must be introduced as a preventative measure, before signs of starvation and emaciation start

to show and whilst the reindeer are still strong enough to adequately adapt to the feed. This can be difficult to navigate for herders especially since many herders wish to delay or avoid feeding as long as possible. Similarly, once reindeer have adjusted to supplementary feeding it cannot abruptly be stopped but rather a gradual shift back to natural grazing resources must be allowed.

Outbreaks of diseases, such as infections of eyes and muzzles, as well as parasites, are more likely to occur and are more easily transmitted when animals are kept at high densities in corrals. A high animal density also increases stress levels, which leaves animals more susceptible to op-



Photo: M. Tryland

portunistic infections. Sufficient space and good hygienic conditions in corrals are essential in order to allow sufficient movement for reindeer to maintain a good physical condition, and to reduce the risk of infections due to too close contact between animals.

One herder from Finland observed that supplementary feeding enhances milk production in female reindeer, contributing to calf survival. On the other hand, supplementary feeding prevents reindeer from losing their fat reserves during winter, a period when animals are supposed to be lean. She wondered whether this could cause problems with calving due to the over-growth of the fetuses. She also pointed out that supplementary feeding changes natural selection, as also weaker animals will survive, perhaps decreasing the overall fitness of the herd.

“Due to supplementary feeding, reindeer become lazy and they give up on digging.”

(Herder from Finland)

5.7 Supplementary feeding may affect reindeer behavior

Herders observe changes in reindeer behavior to varying degrees when the animals receive supplementary feeding. Some herders from Sweden and Finland reported changes in activity patterns, resulting for example in an unwillingness of reindeer to start the migration to spring or summer pastures. Some participating herders reported that reindeer leave feeding sites in late winter or early spring, starting their migration to the calving areas, even if the snow cover is still

deep. However, supplementary feeding increases the level of tameness of reindeer, which may facilitate handling. As a disadvantage, increased tameness can however lead to intensified tensions with the majority society.

There was no uniform agreement on the general time it takes before reindeer change their behavior in response to supplementary feeding. Whilst for some individuals, this may take years, others adapt quickly. Long-term consequences of these behavioral changes are still unclear, as the behavior might differ between years and herding districts.

“If reindeer change their behavior, reindeer husbandry will become a farmer’s job. This is very alarming. They have changed their behavior in such a short time!”

(Herder from Sweden)

5.8 Supplementary feeding may threaten traditional and experience-based knowledge and culture

Herders were concerned that increased use of supplementary feeding erodes or erases traditional- and experience-based knowledge, including the Sámi cultural heritage, regarding e.g. use of winter pastures by reindeer. Herders acquire knowledge of the landscape and of the interaction between nature, reindeer and the herders through direct experience over a long time. If lost, such knowledge will not be transferred to future generations of herders and might affect their ability to use their grazing areas in response to dynamic environmental conditions.

“Those of us that grew up without supplementary feeding, we know...but what about the next generation? Perhaps they lose the knowledge about the mountains, what terrain to use under what conditions and season. My fear is that this knowledge might get lost over time.”

(Herder from Norway)

The herders who participated pointed out that herding practices are based on collective efforts and require cooperation between herders. Working together with different kinds of herding tasks throughout the year has ensured close social relationships (e.g. living together in cabins and sharing common tasks as round-ups). A herder from Finland noted that for them, supplementary feeding changes the livelihood and isolates herders from each other during the long winter. In the regions where winter corrals are the only viable solutions, herding tasks become individualized.



Photo: H. Rautiainen

5.9 Supplementary feeding may weaken rights to grazing lands

In combination with for instance climatic drivers and carnivore pressure, other forms of land use contribute to the necessity of supplementary feeding. However, the complexities and intricate details of supplementary feeding are often unknown to other land users, who may thus consider supplementary feeding as an obvious choice to buffer shortages in grazing resources. A common fear among herders in all three countries is the risk of losing rights to pasture lands if other land users and governments use the seemingly ‘success’ of supplementary feeding as an argument for further exploration. This is a particular concern, as other forms of land use are predicted to expand in the reindeer husbandry area in all countries.

“With the wind power developments, we see no other options than feeding. But we don’t give up. We need to get better at it, although this is not what we want to do.”

(Herder from Norway)

5.10 Supplementary feeding affects vegetation and soils

High animal concentrations on a spatially limited feeding site, but during extended time periods can cause local damage to vegetation and soil erosion due to intense trampling around the feeding places. High density of reindeer in a limited area for a longer time also has a fertilizing effect, resulting in vegetation changes and nutrient leakage. Terrestrial lichens are particularly sensitive to high nutrient input and trampling, and in some areas might become replaced by grasses as a consequence of feeding. The choice of feeding locations is therefore important. For example, when feeding free-ranging reindeer in winter, some herders prefer to feed in areas without abundant lichen cover, so that good winter pastures remain unaffected. By feeding in areas with partly accessible pastures, the reindeer are able to switch between natural grazing resources and the feed. In this way, supplementary feeding can allow herders to use grazing areas that otherwise would not offer enough resources for reindeer.

5.11 A risk of supplementary feeding affecting public acceptance

Some herders feared that increased need of supplementary feeding could change the image of reindeer meat as a clean and sustainable product, affecting the status of reindeer husbandry as a whole. Herders therefore emphasized the need to raise public awareness and acceptance of supplementary feeding under exceptional circumstances.

“Due to supplementary feeding, there has been arguments to permanently move reindeer to corals. This is however not a viable option at all.”

(Herder from Finland)

Herders from Finland pointed out that animals that will be slaughtered during autumn are not the ones being fed during winter. As calf slaughter during autumn is a common practice in all countries, most of the meat sold is from reindeer that never received supplementary feed to a substantial amount.

Box 3: Nutrition

Reindeer show pronounced seasonal variation in their appetite. Food intake is low throughout winter until spring, when it begins to rise, peaking in late summer and falling rapidly again in the autumn (e.g. McEwan & Whitehead, 1970; Larsen et al., 1985). Even though reindeer are adapted to little available food in winter, they suffer when the pastures are completely unavailable due to ice and deep snow.

After four days of starvation, only 1% of the rumen bacteria breaking down cell walls in plant material was present in the rumen fluid (Aagnes et al., 1995; Mathiesen et al., 2005). Starvation therefore makes reindeer vulnerable to changes in the diet, as their digestive system needs time to adapt to the new food. If reindeer are in poor condition when feeding is initiated, the weakest animals might die before they are adapted to the new diet. Research shows that early harvested grass, or concentrates are suitable as supplementary food for reindeer (Aagnes et al., 1996; Aagnes & Mathiesen, 1996). However, not all reindeer will eat this food instantly, but need time to get used to the taste. The main challenge to the reindeer herders is therefore not to wait too long before supplementary feeding is initiated.

Commercial concentrates adapted for reindeer are available, but are expensive. Some reindeer herders therefore prefer hay or ensiled grass in big bales. Due to the low content of water in hay (ca 17%), it is easy to transport and handle (but must be stored dry). Ensiled and plastic wrapped big bales might be stored outdoors, but they contain much water (45-82%) and is difficult to handle. Digestion of plant fiber such as cellulose in the rumen of reindeer may be limited by the availability of easily digestible energy in the form of sugar (Norberg & Mathiesen 1998).

Harvest time is important for both hay and ensilage. Second cut or early first cut is recommended. Important quality parameters of baled grass are: correct ensiling processes secured by adding ensilage chemicals (improved palatability and reduced probability of failed fermentation), complete wrapped bales with plastic and no contamination of the grass by soil or feces. Sufficient content of dry matter should be higher than 25% on weight basis. Below that amount, the frozen bale (in winter) will contain much ice. Melting and warming ingested ice to body temperature is energy consuming for reindeer - energy they need to maintain life functions during winter. Wet and frozen bales are also difficult to handle/spread out.

Svein Morten Eilertsen

References: Aagnes TH, Sørmo W, Mathiesen SD. 1995. Ruminal microbial digestion in free-living, in captive lichen-fed and in starved reindeer (*Rangifer tarandus tarandus*) in winter. *Appl Environ Microbiol.* 61:583-591. • Aagnes TH, Blix AS, Mathiesen SD. 1996. Food intake, digestibility and rumen fermentation in reindeer fed baled timothy silage in summer and winter. *Journal of Agricultural Science*, 127: 517-523. • Aagnes TH, Mathiesen SD. 1995. Round baled grass silage as food for reindeer in winter. *Rangifer* 15: 27-35. • Mathiesen SD, Mackie RI, Aschfalk A, Ringø E, Sundset MA. 2005. Microbial Ecology of the gastrointestinal tract in reindeer-changes through season. *In: Holzapfel, W, Naughton P (Eds.) Microbial Ecology of the Growing Animal; Biology of the Growing Animals, Vol. 3, Elsevier Press, Oxford, pp 73-100.* • Larsen TS, Nilsson NO, Blix, AS. 1985. Seasonal changes in lipogenesis and lipolysis in isolated adipocytes from Svalbard and Norwegian reindeer. *Acta Physiol. Scand.* 123:97-104. • McEwan EH, Whitehead PE. 1970. Seasonal changes in energy and nitrogen intake in reindeer and caribou. *Can. J. Zool.* 48:905-913. • Nordberg HJ, Mathiesen SD. 1998. Feed intake, gastrointestinal system and body composition in reindeer calves fed early harvested first cut timothy silage (*Phleum pratense*). *Rangifer*, 18:65-72.



Summary of topics discussed with regard to supplementary feeding. Reasons for feeding include difficult snow conditions, loss of grazing resources due to activities by other land users and presence of predators. Societal threats include threats to transmission of experience-based and traditional knowledge, loss of access to grazing areas and economic trade-offs. Con-



cerns for reindeer are related to reindeer health and changed behavior. Dangers to the ecosystem result from local changes in vegetation due to effect of fertilization by feces or soil erosion due to high animal densities at feeding sites.

6. Practical experiences

Herders shared their practical experiences of supplementary feeding, and raised their concerns related to these, within and between the countries. In general, the participating herders found many similarities regarding practices and concerns between the countries. Nevertheless, important differences do exist. These can be related to different vegetation zones in which the respective herders keep their herds during winter, as herders with winter pastures above the tree line have different experiences and practices compared to herders who have their animals in the lowland forests.

The following section summarizes some specific examples of practical experiences and concerns shared by participants, but also illustrates complexities with these practices. These cases cannot present an exhaustive level of detail, but rather offer an overview of the diversity of challenges and responses based on the participants' experiences. The examples indicate from which country the individual or collective experience originates from, but can indeed be very place-specific.

6.1 Individualization of herding livelihood and erosion of communities and social practices

According to some herders from Finland, supplementary feeding may lead to individualization and isolation of herding practices, and therefore may cause an erosion of communities, social practices and shared tasks. They also believe that supplementary feeding practices has the potential of generating new valuable knowledge of how to sustain the livelihood in dynamic landscapes and interaction with other forms of land use. These include new forms of collaboration: for example, herders from Finland see options in producing and sharing own feed on abandoned agricultural fields, including economic and employment opportunities.

Table 6.1: Social practices

Responses, strategies and experiences	Example
Increase collaboration and social cohesion to share the work of feeding on feed production	all
Consider needs and requirements for new knowledge and skills as reindeer herding practices are changing	all
Raise public awareness that supplementary feeding can help adapting to changing socio-economic and natural environments, but it should not be implemented at the expense of tradition and culture	FIN
Where possible, use farming equipment to ease some of the work	all

Photo: J. Mustonen



6.2 Supplementary feeding changes reindeer behavior

If winter feeding is only given irregularly, reindeer might have difficulties in adapting their behavior and digestive system to the feed. Some participants therefore argued for uninterrupted feeding during winter. Here we note major differences between those who view feeding in terms of an emergency and those who employ it as a supplementary response.

On the other hand, reindeer that have adapted to supplementary feeding will need time to switch back to the natural pastures, once grazing conditions have improved. There is also a fear that reindeer stop using natural pastures, if they become used to being fed. Feeding therefore cannot be stopped abruptly.

However, one Norwegian participant reported that as soon as the spring arrives, the animals leave the feeding stations, as they clearly prefer freshly emerging vegetation over pellets or other types of feed.

Similarly, the animals will have to be eased into new types of feed slowly, to allow the digestive system to adjust. Some herders wondered if reindeer at the end of a difficult winter are more exhausted from the wintry conditions, or from being fed or kept in corrals that allow only limited physical activity. However, it remains difficult to generalize the reaction of reindeer to supplementary feeding. Some reindeer have greater feed intake, or alter their behavior faster and more completely than others do. This may in-



Photo: M. Tryland

crease conflicts with the surrounding society, as perceived disturbances by tame reindeer increases. Tame reindeer also are vulnerable to dogs running loose, for example during the hunting season.

When fed in corrals, the rank order between the animals becomes more pronounced, and females may become more aggressive. Separation of calves from females might therefore become necessary, especially as calves during a difficult winter are often in worse condition than the adults. On the other hand, separation of female reindeer and calves may elicit negative effects. Breaking this relationship could have negative impacts on the survival of young reindeer.

Participants discussed the amount of feed consumed by reindeer. According to the experience by Finnish herders, food consumption decreases over time, as reindeer adapt to the type of feed and its availability.

Table 6.2: Reindeer behavior

Responses, strategies and experiences	Example
Slaughter reindeer that get too tame	FIN
Locate the corrals far enough from settlements, to avoid reindeer becoming too used to people and their dogs	FIN

6.3 Predators can influence decision making and practices in supplementary feeding

The presence of predators does, for some herders, influence the need to feed reindeer. Where carnivores are present, the animals need to be gathered or the herd needs constant surveillance by “guarding the edges” of the herd. Corrals may offer protection, in particular if the presence of predators interacts with difficult winter conditions, when reindeer tend to spread out in search for forage. However,

when kept in corrals, reindeer may be vulnerable to attacks by eagles. Corrals need to be constructed with this protective function in mind, as well as considering aspects related to reindeer health. However, some reindeer herders from Finland considered fences inadequate protection of reindeer from predation, instead they regarded the proximity of people as fundamental in reducing predation. During calving this is however not a good solution, as female reindeer need to be undisturbed with as little disturbance as possible.

Table 6.3: Predators

Responses, strategies and experiences	Example
Make sure that corrals offer protection and fences are high enough when the snow is deep	SW
When feeding free-range, less spread out reindeer herds are easier to protect	NO

6.4 Reindeer health and well-being need attention before, during and after feeding

Diseases and parasites may become a problem especially in corrals where animals are in close contact with each other. These challenges can be mitigated or avoided by corrals large enough to allow movement, fences that separate the herds, or separating/removing weak or infected animals. When feeding in corrals, sufficient space is essential to enable enough movement, so that reindeer remain in good physical conditions and to reduce the risk of infections. Corrals also need to be of sufficient size to offer clean snow; important to avoid contamination and spread of diseases. If infections occur, releasing reindeer from the corrals may become necessary to avoid any further transmission.

Calves require particular attention. As they are especially sensitive to diseases during difficult winters with deep and/or hard snow, herders debated whether they can be separated from females, mainly to offer them more care in terms of warmth and water supply. Sick calves are significantly sensitive, and thus may have difficulties in regaining their health during harsh winters.



Table 6.4: Reindeer health

Responses, strategies and experiences	Example
Spread of diseases and parasite outbreak	
Make sure corrals are of sufficient size to offer space for movement and clean snow	all
Give reindeer an anti-parasite treatment	all
Always make sure the fodder is of good quality and good hygiene is maintained	FIN
Feeding in forests helps avoiding diseases as reindeer are more dispersed, but is difficult in dense forests	FIN
Physical condition of reindeer can be affected in corrals	
Start feeding slowly to avoid digestive problems and allow ruminal microbiota to adapt	all
Feed only enough that reindeer can survive the winter, as too much food may cause health problems and unnecessary costs.	FIN
All reindeer should be fed on time	
Start feeding in good time before reindeer get too weak	all
Feed old female and male reindeer and calves separately to avoid competition for access to fodder	FIN & SW
When feeding insufficient quantities, the dominant animals will get enough, while the low status animals will starve.	NO
A large number of feeding sites is required to ensure that all animals get access to food	NO
Provide the fodder at the same time in all feeding sites to avoid domination of the stronger reindeer over the weaker	FIN



6.5 Economic trade-offs are involved in supplementary feeding

Economic security of the individual herder is dependent on the costs and expenses related to herd productivity and management.

The economy of individual herders is also affected by social and technological change and dynamics. These include increasing financial costs incurred by the necessity of motorized practices. Heavy workloads, for example related to transportation of supplementary feed to strategic places or corrals, put additional stress on both herders and equipment. For example, transport of heavy loads for feeding results in excessive wear and damage on the snowmobiles and sledges and consumes more fuel, as well as the physical demands placed on the herders. As feeding is very time-consuming, it was perceived that the well-being of

herders suffers due to lack of free time outside of traditional important work seasons, such as round-ups in autumn and calf marking in spring or summer.

To increase the economic efficiency of supplementary feeding, cheaper machines and increased automatization would be needed. Wherever possible, local production of fodder should be prioritized over imported fodder, for example by the use of abandoned fields, perhaps supported by government subsidies. In Finland, however, access to governmental subsidies for production of supplementary fodder might be perceived as unfair by those who live in areas where agricultural practices are not possible due to environmental conditions and poor availability of suitable farmland.

Participants also stressed the need for better cost-benefit analyses with regard to supplementary feeding.

6.6 Type and quality of feed require particular attention

Across all of the three countries, it is difficult to assess whether available feed is of a sufficiently high quality. Herders therefore insist on a better cooperation with feed producers to ensure better availability and quality of fodder, as well as quality control. Long term partnerships are an essential means for such an exchange.

The quality of reindeer feed is a daily concern during times when reindeer receive supplementary feeding. Herders identified a fundamental need to further develop knowledge on the factors that influence the quality and quantity of feed.

Providing reindeer with lichens gathered or bought from elsewhere is a choice that partly reduces these concerns. Decades of decreased availability of lichen in Fennoscandia is, however, a practical concern. Due to the recent outbreaks of Chronic Wasting Disease (CWD) in southern Norway, it is now forbidden to collect lichen in southern Norway, resulting in a shortage of lichen as a supplement in Northern Norway. Some Norwegian herders are therefore required to buy lichen from Finland.

Table 6.5: Economy

Responses, strategies and experiences	Example
If possible, grow own feed by utilizing abandoned agricultural fields to reduce costs	FIN
Share machinery if available and collaborate with farmers in the area if possible	FIN
Seek EU subsidies, such as support for maintaining cultural landscapes	FIN
Use subsidies for compensation for losses to predator for covering feeding costs	NO
Open a meat processing business as it could contribute to new employment opportunities	FIN
Compensation for lost pastures (e.g. winter pastures in Sweden) can be used for covering feeding costs.	NO



Photo: K. Majuri

In Finland, other methods to achieve self-sufficiency of feed include hay-making and silage production on fields that have been abandoned due to a long decline of traditional farming. Even in the Sámi homeland in Finland it is not uncommon that herders grow hay for their reindeer from their own or rented fields. Especially if large scale farming is possible, some herders might even produce concentrated fodder themselves from their own harvest. Where production of hay is not possible, as in the northernmost parts of Finland, herders need to buy feed.

Herders from Finland report that hay should not be used as the only type of feed, especially if reindeer are kept in corrals for longer periods. Some natural feed such as lichen, birch leaves, swamp hay (sedges, reeds etc.) are offered as a starter before reindeer digestive systems get accustomed to other types of feed. Usually salt and mineral stones, foliage and hay are offered to reindeer, especially to weaker individuals. Hay and silage are of better quality for reindeer if it has been harvested early in the growing season, according to herders. As a herder from Finland mentioned, it should

be recognized that the hay harvested in early stage is richer in protein which may cause problems for the reindeer. Therefore, caution is necessary with nitrogen fertilization to control the amount of protein. However, according to participants from Sweden and Norway, it can be difficult to find such high-quality hay or ensilage, or locate farmers interested in an early harvest, as an early harvest is less economically beneficial to them. The reason is that the food usually is paid by weight, and not by digestible feed. Delaying the harvest increases the yield (in kg) significantly. If the farmers harvest early to produce high-quality reindeer feed for the herders, the feed would be costly for herders. Correctly produced hay is at low risk for developing toxins, but hay harvested late in the season risks being too rough a texture and may cause bleeding cuts in the mouth, esophagus and rumen of the animals.

Silage is ensiled, stored fodder with a varying dry-matter content (17% - 55%). Baled silage can vary in quality and energy content (depending on species composition, harvest time and ensilage process). Silage below 25% dry matter is unsuitable for reindeer, as it can freeze in winter, so that reindeer use much energy to melt the water in the ingested food. Bales without ensiling supplements often have low energy content and are less tasty compared to bales with ensiling supplements. Baled silage might also contain fungi or unfavorable bacteria if the plastic wrapping is damaged during the fermentation process, the grass is contaminated by manure, soil or without ensiling supplements. Both baled silage and hay might have low suitability as reindeer fodder if the grass is harvested late and contains a lot of non-digestible fiber. As baled silage is often paid per unit, and not per concentration content/ digestible content, it can be quite expensive or difficult to get hold of in a quality suited for reindeer.

Swedish herders experienced that the quality and composition of ensilage vary considerably and that it is therefore important to keep track of the feed's batch numbers to maintain as much consistency as possible to avoid gastrointestinal disturbances for the reindeer.

Table 6.6: Type of feed

Responses, strategies and experiences	Example
Inform about reliable producers of feed to ensure high quality fodder	FIN
Make long-term deals with fodder producers to provide incentives to produce fodder that fits to the buyers' needs and to guarantee the quality of the fodder	FIN
Collaborate with owners in possession of their own fields to produce feed	FIN
Buy feed from Finland because of CWD outbreak in Norway	SW & NO
Share knowledge and learn from each other to improve feeding practices	FIN
Need for more knowledge about quality on baled silage	NO

7. Knowledge gaps

Herders participating in the workshop identified a number of knowledge gaps and areas of uncertainty (fig. 3). These knowledge gaps were revealed through discussions and exchange between the herders themselves, and between herders and researchers. The identified areas provide valuable input to policy and research communities as they in-

dicating concrete needs for further knowledge development or where there is a need for a more efficient distribution of information already available.

The knowledge gaps below are not weighed against each other.

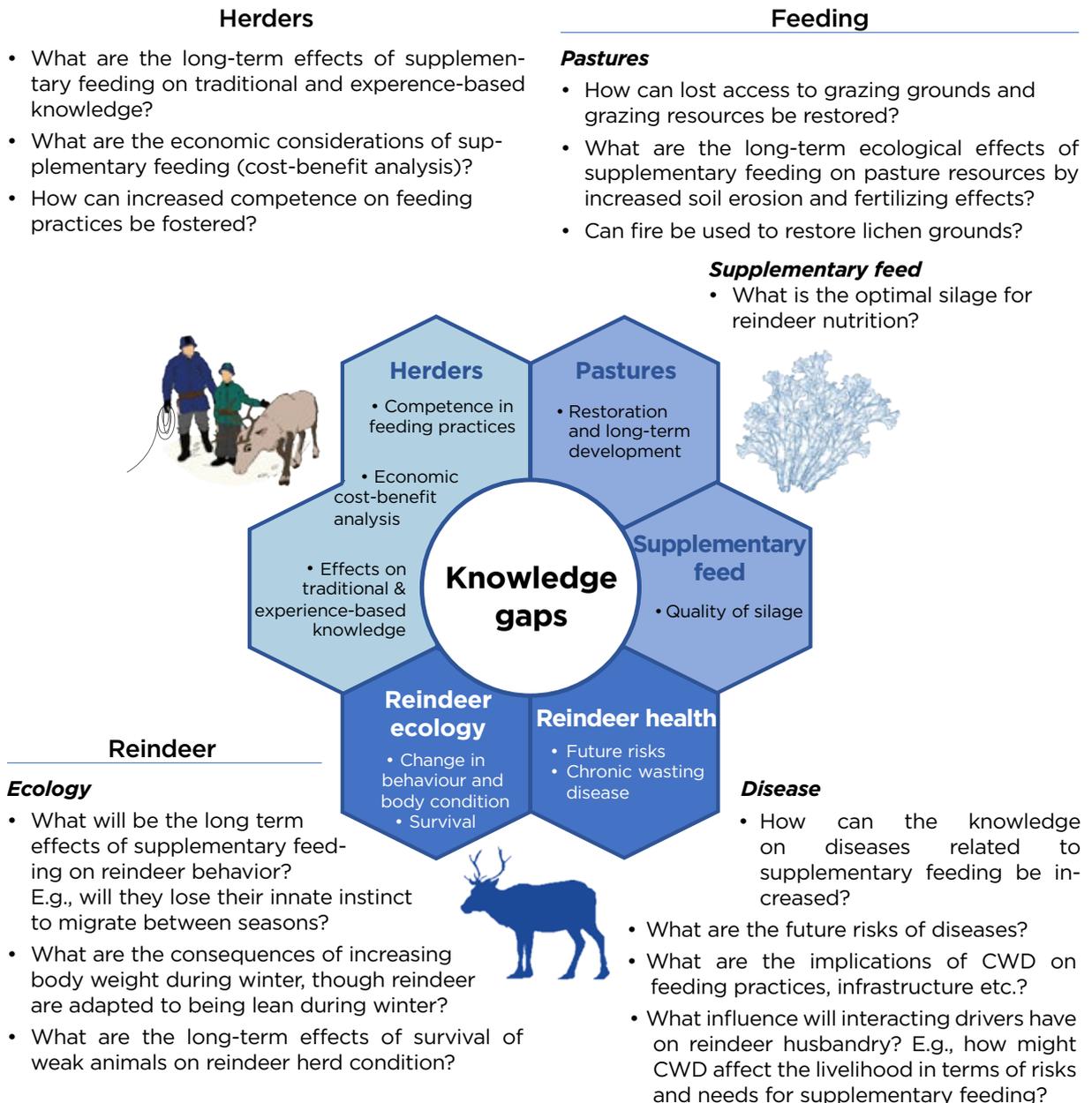


Figure 3: Examples of major knowledge gaps raised during the workshop

8. Way Forward

The participating herders from the three countries clearly expressed the need for similar activities to the workshop. It was clear that when herders from different parts of Fennoscandia got together, they immediately initiated discussions and exchange about each other's practices. Interest in and comparisons of how "things work" in other places permeated the workshop. Participants also explicitly expressed desire for and need of increased communication across borders - arenas where they can discuss shared and urgent topics from a herding perspective.

Ideally, the next workshop could be held in closer connection to ongoing herding activities, and include field visits to grazing areas or local feeding sites. However, we see the present workshop as the first step in continued knowledge co-production, on which we can build further activities that will include closer connections to the herders' own environment.

Photo: C. Risvoll





Photo: T. Horstkotte

Epilogue: Final reflections by workshop organizers

To conclude this report, we would like to emphasize that there are multiple constraints placed on herders' decision-making to deal with lack of access to, or shortage of natural grazing resources. We strongly agree with the herders, whose voices are documented in this report, that the possible impacts of supplementary feeding on long term sustainability of reindeer husbandry need to be recognized. We would also like to raise awareness of the political dimension that can be inherent in supplementary feeding. Supplementary feeding does not contribute to finding a systemic solution to the underlying problems for reindeer herders that are discussed in this report. Rather, it can be understood as a technical remedy of solving others' dilemmas, if there are conflicts between their own interests and those of reindeer herders. Yet, there are situa-

tions, especially connected to ongoing climate change, but also to other types of encroachments that make supplementary feeding a necessary response as crisis relief.

We wish to build on this dialogue and knowledge co-production process in the near future to discuss strategies with herders, as they perceive them - such as how to provide access to encroached or inaccessible grazing grounds or to restore natural forage resources where they have been negatively affected by other forms of land use. In our view, such strategies could provide a more equal way of sharing the burden of responsibility to maintain a reindeer husbandry that is culturally, economically and ecologically sustainable.

Appendix: Reindeer Husbandry in the three countries – an overview

Norway

Reindeer husbandry in Norway is regulated through the Reindeer Husbandry Act (LOV-2014-03-28-9). Reindeer husbandry is carried out on both state-owned and privately-owned land and close to 40% of the country's land area is used for reindeer herding. Reindeer herders' rights to land are based on old doctrines of customary rights (Allard, 2015) and according to national legislation, reindeer owners must be of Sámi descent, except a few concession areas in southern Norway where both Sami and Norwegians own reindeer. The Sami reindeer husbandry area is divided into six regions and extends from the far north of Norway to as far south as former Hedmark County (now Innlandet). These regional areas are further divided into 72 summer and year-round grazing districts and additionally 10 districts that are being used as autumn and winter pastures. In these, the use of seasonal grazing grounds and division of workload among reindeer owners is organized into operating groups called *siida* / *sitje*. Each *siida* / *sitje* is divided into shares (<https://www.reinbase.no/nb-no/Studer-reindriften/Reindriften-i-Norge>). There are large variations in herding practices in the reindeer grazing districts, both internally in the various regions and between regions. Great topographical and climatic variation exists within the reindeer husbandry area in Norway. In the far north (former Finnmark County, now part of Troms-Finnmark), reindeer graze in coastal areas during summer and in inland areas during winter. Further south (former Troms County, now part of Troms-Finnmark), grazing patterns differ at local scales. Some herds graze in coastal areas throughout the whole year, while others migrate to the inland in winter. In Nordland and Trøndelag Counties, there is also a variation between grazing at the coast or in the inland during winter, depending on different factors such as access to coastal pasture, carnivore pressure or ice-locked pastures. In some districts there are only short distances between the seasonal pastures and it is run as a year-round operation where the reindeer remain more or less in the same areas throughout the year. Other districts have large distances and therefore long migration distances between winter pastures and pastures for the snow-free period. In Norway, the number of reindeer in the spring herd is approximately 240 000, and there are about 3 233 registered reindeer owners. Traditionally, the use of seasonal pastures

and the division of labour are organised within *siidas*. These are at present formalized into reindeer herding districts (<https://www.reinbase.no/nb-no/Studer-reindriften/Reindriften-i-Norge>).

Sweden

In Sweden, the reindeer herding right belongs to the Sámi people and is specified in the Reindeer Husbandry Act (1971). It includes the right to “use the land and water for maintenance for themselves and their reindeer”. The reindeer herding right is based on immemorial prescription (“urminnes hävd”), meaning that reindeer herding has been practiced for so long that it has developed into a right of its own. In order to practice reindeer husbandry, membership in a reindeer herding district (*sameby*) is required according to the present legislation. The reindeer herding district constitutes a geographic, economic as well as legal entity. The members of a herding district are usually organized in winter groups (*siida*), which may consist of one or several reindeer herding enterprises.

The reindeer husbandry area covers approx. 50 % of Sweden. Reindeer husbandry is practiced in two distinct forms. Migratory herding districts (“fjällsamebyar”) practice seasonal rotation, sometimes assisted by trucks, between summer grazing grounds in the mountains and winter grazing areas in the boreal forest. In forest herding districts (“skogssamebyar”), reindeer stay in the boreal forest throughout the year. Of the 51 reindeer herding districts, 33 districts practice migratory husbandry, while forest reindeer husbandry is practiced in 10 districts. The remaining 8 districts are concession districts. In concession districts, reindeer herding resembles forest herding but reindeer owners may be non-Sámi, though their animals are herded by Sámi. There were 4 665 reindeer owners registered in 2019, and the reindeer population after slaughter was approx. 241 013 (statistics from Sametinget - <https://www.sametinget.se/renstatistik>).

Finland

Unlike in Sweden and Norway, both Sámi and non-Sámi people have traditionally engaged in reindeer herding in Finland. In the 18th century, northern Finnish peasants had learned the practices from southern Sámi (Kortesalmi 2007). Due to these historical developments and cultural

amalgamations many herding families and communities have been and still are mixed and many northern Finns have learned to consider reindeer herding as an essential part of their cultural heritage.

In Finland, the reindeer husbandry area is divided in to 54 herding cooperatives called “*paliskunta*” which are members of the Reindeer Herders’ Association (Paliskuntain yhdistys). Reindeer husbandry is part of the Ministry of Agriculture and Forestry and it is regulated through the Reindeer Husbandry Act (848/1990).

Even though the reindeer husbandry area is large, covering 36% of the total area of Finland, with environmental, cultural and economic disparities, governmental decisions apply for all herding cooperatives. Three main areas have been defined (Reindeer Herders’ Association, 2014):

1. The “Sámi homeland” in the North, where reindeer herding has a stronger position in consideration with other forms of land use and conflicting interests.
2. The “area specially intended for reindeer husbandry” where, contradictory, the biggest industrial developments in Lapland are located; and
3. The “southern reindeer husbandry area” which represents about half of the reindeer husbandry area in Finland.

There were 4 394 reindeer owners in Finland between 2017-2018 and the number of reindeer was 191 188 in the year 2017-2018 (Poromies, 2019).

References

- Allard C. 2015. *Renskötselrätt i nordisk belysning*. Makadam Förlag • Kortessalmi J. 2007. *Poronhoidon synty ja kehitys Suomessa*. Tammer-Paino Oy, Tampere • Poromies. 2019. Porotalouden tilastoja 2017-2018. Poromies 2/2019, Paliskuntain yhdistys, p.36-37 • Reindeer Herders’ Association. 2014. *Guide to examining reindeer husbandry in land use projects*. Pohjolan Painotuote Oy, Rovaniemi
<https://www.reinbase.no/nb-no/Studer-reindriften/Reindriften-i-Norge>
<https://www.sametinget.se/renstatistik>



*“S*upplementary feeding gives us
several challenges and concerns...

*We are urged to feed, but this
has some consequences for
us, for our culture and
knowledge.”*

