

Facing the limit of resilience: perceptions of climate change among reindeer herding Sami in Sweden

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Background: The Arctic area is a part of the globe where the increase in global temperature has had the earliest noticeable effect and indigenous peoples, including the Swedish reindeer herding Sami, are amongst the first to be affected by these changes.

Objective: To explore the experiences and perceptions of climate change among Swedish reindeer herding Sami.

Study design: In-depth interviews with 14 Swedish reindeer herding Sami were performed, with purposive sampling. The interviews focused on the herders experiences of climate change, observed consequences and thoughts about this. The interviews were analysed using content analysis.

Results: One core theme emerged from the interviews: **facing the limit of resilience**. Swedish reindeer-herding Sami perceive climate change as yet another stressor in their daily struggle. They have experienced severe and more rapidly shifting, unstable weather with associated changes in vegetation and alterations in the freeze–thaw cycle, all of which affect reindeer herding. The forecasts about climate change from authorities and scientists have contributed to stress and anxiety. Other societal developments have lead to decreased flexibility that obstructs adaptation. Some adaptive strategies are discordant with the traditional life of reindeer herding, and there is a fear among the Sami of being the last generation practising traditional reindeer herding.

Conclusions: The study illustrates the vulnerable situation of the reindeer herders and that climate change impact may have serious consequences for the trade and their overall way of life. Decision makers on all levels, both in Sweden and internationally, need improved insights into these complex issues to be able to make adequate decisions about adaptive climate change strategies.

Keywords: *climate change; indigenous peoples; Sami, reindeer herding; perception; resilience*

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Global climate change is unequivocal and the Arctic regions are experiencing the most rapid increase in temperature on the planet, at approximately twice the global average rate, most pronounced changes occurring during winter and spring (1). The impacts of climate change have been evident in many Arctic societies with detrimental consequences in some places, especially for the indigenous populations (2). The northern part of Sweden contains a small area above the Arctic circle, but the main part in the subarctic region might also be affected by early climate impacts, influencing the people in this region. The

indigenous peoples of Sweden, the Sami, live here. The traditional Sami land, called Sápmi, covers four countries: Northern Norway, Northern Sweden, the northernmost part of Finland in Scandinavia and the Kola Peninsula in Russia, see Fig. 1. There are approximately 100,000 Sami in these four countries of whom 20, 000 Sami live in Sweden (3).

A group of people in this population, the reindeer herders, live very close to nature and are hereby exposed to the potential effects of climate change more than others. Sami reindeer herding represents a tightly intertwined human–environmental system in which indigenous people interact closely with an ecosystem upon which they depend for their way of life. The regions in the Nordic countries where reindeer herding is practised are sparsely

The present article has not been previously published and is not under consideration elsewhere.

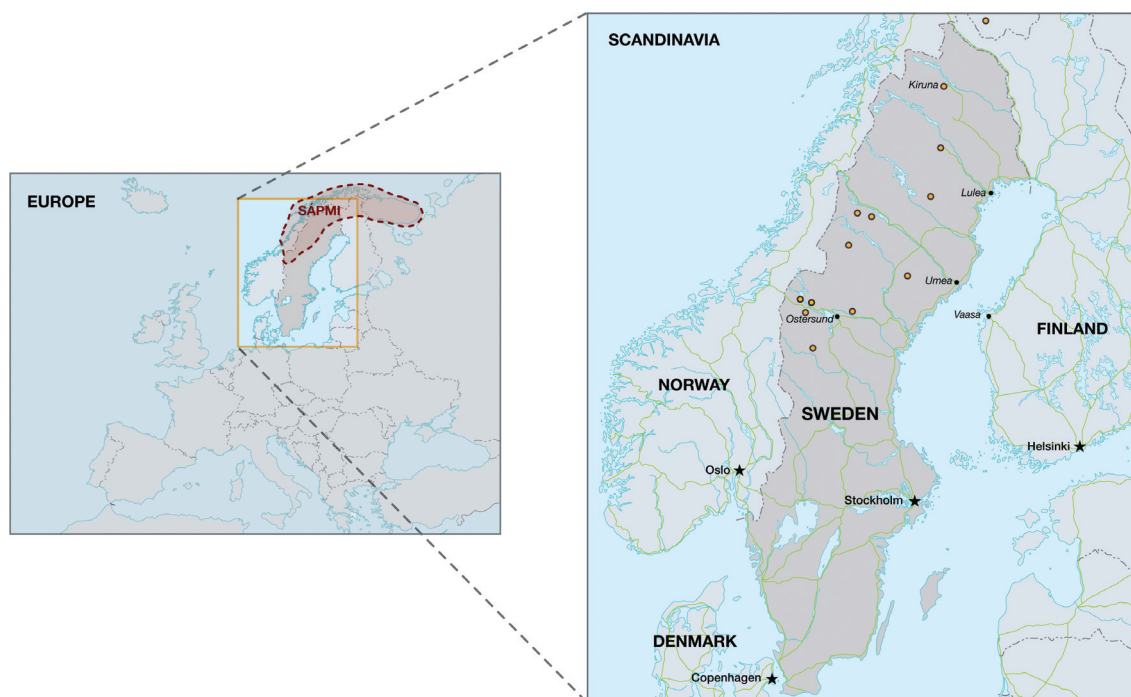


Fig. 1. Map showing the geographical distribution of participants marked with circles. Reproduced with permission from www.nopolo.se

populated though rich in infrastructure, transport and electronic communication networks, compared to other circumpolar regions. The Sami traditional trades include hunting, fishing, handicraft and reindeer herding. Around 10% of the Swedish Sami are involved in reindeer herding. The majority of Swedish Sami are integrated in the Swedish society, for example in terms of occupations and schooling.

According to Hassler et al. (4), the Sami overall health status shows generally small differences in risk of major diseases and causes of death compared with the non-Sami population. The overall life expectancy of Sami people equals that of the rest of the Swedish population: 74.9 years for Sami men compared to 74.6 years, 80.0 years for Sami women compared to 80.3 years (4). In comparison with other indigenous peoples, the successful epidemiological transition of the Sami population is globally unique. It is attributed to a gradual integration of traditional and modern life styles, high living standards and a high educational level. In terms of socioeconomic standards, the overall annual medium net income for Sami between 1970 and 2000 shows small differences compared with the non-Sami population, although the income for reindeer-herding Sami men was considerably lower. In fact, in reindeer herding Sami households, the majority of the family's net income today comes from women being employed outside the household (5).

Approximately 2,500 Swedish Sami in 51 Sami villages have their main income from reindeer herding, and the

number of reindeer has fluctuated around 250,000 in the last 5 years (6). Reindeer herding is practised on 52% of Sweden's surface, and the conditions for the trade vary to a great extent in different regions of the country. Reindeers are principally managed in a Nordic manner, rich in tradition: there are two annual migrations moving the animals between geographically separate summer and winter pastures. Reindeer herding in Sweden is entirely based on the sustainable and free exploitation of natural pastures. The main income in reindeer herding in Sweden comes from commercial trade with reindeer meat and from economic compensation for predation losses. Reindeer predators in Sweden include brown bear (*Ursus arctos*), lynx (*Lynx lynx*), wolf (*Canis lupus*), wolverine (*Gulo gulo*) and golden eagle (*Aquila chryseatos*) (7).

The weather patterns covering reindeer pastures are highly complex and display a large degree of regional, local and temporal variation. Changes in temperature, weather and precipitation can affect vegetation and the animals' possibility to access grazing. Especially, where climate change affects the freeze-thaw cycle, powerful impacts can be expected (2).

Aim

The aim of this study was to explore the experiences and perceptions of climate change among reindeer herders in the Swedish indigenous population: the Sami.

Method

Study design

The study was a qualitative, descriptive study, based on in-depth semi-structured interviews using open-ended questions. Individual interviews were considered the most appropriate method to gain an in-depth understanding of the reindeer herder's views and perspectives on climate change. Individual interviewing might enable the reindeer herders to express emotions or discuss sensitive issues more easily. In addition, it was also considered the most suitable method, as a geographical dispersion of the interviewees was regarded as very important due to the large range and variation in conditions for reindeer herding in different parts of Sweden. The reindeer herders work all week long in constant readiness for the needs of the herd, and it would have been very complicated and difficult to gather a group of herders from different parts of northern Sweden at a specific time and place. Individual interviews also met the reindeer herders' need for flexibility.

The study obtained consent from the Sami Parliament and was approved by the Research Ethics Committee at Umeå University (dnr 09–193 § 48/09).

Sampling of informants

The sampling was purposive, aiming at maximum variation with an effort to include reindeer herders of different sex and age, active as well as retired herders and opinions from different regions in Swedish Sápmi. The initial two interviewees were recruited during the Jokkmokk Winter Conference 2009. After that, the heads of different Sami villages were contacted to reach potential interviewees. Some of the participants were found through the so-called snowballing technique, where informants were asked to suggest other relevant participants. The informants were contacted by phone and if they agreed to participate, asked to choose the time and place for the interview.

Study population

The interviewees were 14 reindeer herders from all over Swedish Sápmi, 3 women and 11 men, representing 11 different Sami villages. The median age was 56, age ranging between 16 and 75. The two youngest participants were still students but were brought up in reindeer-herding families and worked with reindeer herding during holidays. Both planned a future as reindeer herders. One of these young interviewees worked with a reindeer herd situated in Norway, not far from the Swedish border but had experiences in reindeer herding in both Sweden and Norway. Seven of the interviewees were still full-time herders, four were retired full-time herders and one person had another occupation and worked part-time. The average number of years with

reindeer-herding experiences among those working as reindeer herders was approximately 39 years. The geographical distribution of the participants in this study is shown in Fig. 1.

Data collection

The interviews were conducted during 3 months in the spring of 2009.

All interviews were performed by Maria Furberg in Swedish, which together with Sami is the native language of the interviewees. The interviews were conducted at places chosen by the participants themselves and most of them took place in the homes of the interviewees. The interviews were digitally recorded and lasted between 30 and 80 min. An interview guide was used and the participants were asked to reflect upon

- what they knew about climate change
- experiences of changes in their environment over time
- their thoughts about these changes
- the future for reindeer herding

Throughout the process of interviewing, the interview guide was evaluated and developed further several times using an emergent design. Maria Furberg wrote brief research notes to preserve reflections and thoughts emanating during the interviews. After having performed 14 interviews, it seemed that the range and variation in experiences and perceptions of climate change had been captured and that saturation was reached.

Data analysis

The interviews were analysed using qualitative content analysis as described by Graneheim and Lundman, a method similar to the one described by Krippendorff (8, 9). In the systematic analysis, both the manifest content and the latent meaning of the text were captured, aiming at an understanding of the reindeer herder's experiences and perceptions of climate change. Each interview was transcribed verbatim, five of them by Maria Furberg herself. To start with, all interviews were read several times to obtain a sense of the whole. The analysis then proceeded with detailed analysis of each interview and an open coding process with the use of the Open-Code software (10, 11). The text was divided into meaning units that were then labelled with codes capturing the contents of the units. A meaning unit comprises words, sentences or paragraphs containing aspects related to each other through their content and context (8). After all interviews had been coded once, a second round of coding took place, refining codes to make sure that the latent meaning would be captured. The codes were carefully evaluated so that they did refer to the same aspects in-between interviews. The coding was done also by another researcher to ensure

concordance in the interpretations and thereby increase trustworthiness.

Codes with a similar content were grouped into sub-categories. These sub-categories formed five main categories. The process of analysis hereby developed from organising the data to organising ideas generated from the data, as described by Starrin (12). A continuous development of the codes, sub-categories and categories was carried out throughout the whole process by constantly moving backwards and forwards in the material: from the whole to parts of the text. Finally, one theme emerged that brought the five main categories together. An example from the analysis process is presented in Fig. 2 showing a meaning unit, codes, sub-categories and a category.

Results

In the interviews, the herders talked about their everyday lives, impacts of changes in their environment and how different circumstances affect their work and restrict their ability to adapt. Based on the codes and developed categories, one core theme emerged that characterises how the reindeer herders viewed their current situation, especially in the light of climate change: reindeer herding is facing the limit of resilience. The five categories describe how everyday life as a reindeer herder has changed over time, especially during the last 10 years and the impacts these changes, including climate change, have had on reindeer herding. In the following text, each section is titled with the category, the **sub-categories are indicated in bold** and quotations are included to illustrate how the interpretations are grounded in the data. Fig. 3 gives an overview of the findings illustrating the relationship between the key concepts in the interview guide, sub-categories, categories and the emerging theme.

It is like the seasons have been disturbed

The last 30 years have seen major changes in the natural environment and the weather. The interviewees were worried about the impact these changes have had and may have on reindeer herding. The herders in our study pointed out that, although changes have always occurred in the natural environment, the current changes are not

ones they recognise. These environmental changes included the following:

The interviewees felt the weather and the seasons have changed and described a feeling of the year having been ‘regeared’, rearranged in some way with the seasons being disturbed. The **autumns are longer, wetter and warmer** with the temperature hovering around zero degrees (°C) for an extended period of time. The herders described a delay in the onset of autumn, and some had also noted a shift in the oestrus of the reindeer a few days later than previously, which means animals can be slaughtered later than they were before. If there is no autumnal night frost, then the mushrooms do not freeze and die and that makes it more difficult to herd the reindeer for slaughter. During normal migration, both the reindeer and herders must cross frozen bodies of water. However, according to the interviewees, the **waters freeze over much later**, which affects the migration to the winter-grazing lands especially for Sami villages that have large rivers along their migration routes.

Herder 3: when we moved down in the past, the waters froze in the autumn, there was a bit of snow, it was cold, it started in October already. The waters froze in October, so we used to move, sometimes we’d move a month before Christmas and we’d use all the lakes. There are lots of lakes along our migration routes and they used to be frozen over then but now they’re not.

The interviewees described how snow can come very early but then disappear again and then it can keep on raining and snowing right up until Christmas. As a result, the lichen freezes in a sheet of ice close to the ground forming ‘ice bark’; the pasturage becomes ‘locked’, thus making it impossible for the animals to reach. In early autumn, sleet can also stimulate the reindeer to start migrating too early. The resulting slushy, wet and unstable autumns were a source of considerable worry to the interviewees as pastures that freeze over early can remain frozen the whole winter preventing the reindeer from grazing properly.

Herder 13: Yes, but it’s as if everything has been regeared, the whole year has kind of changed gear . . . When I started reindeer herding, you could drive a snowmobile in the middle of October and it

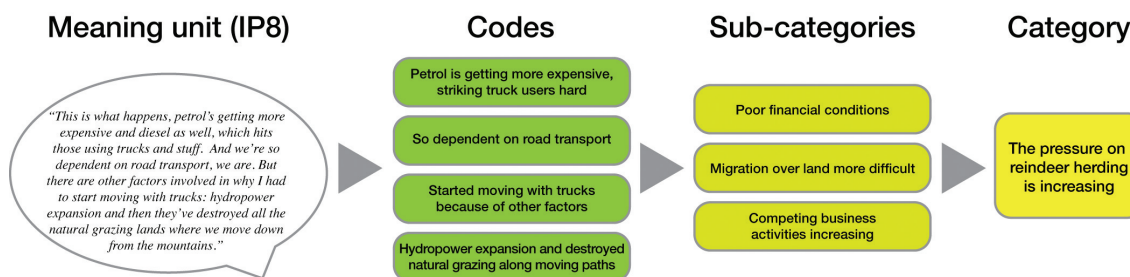


Fig. 2. The coding process moving from a meaning unit to a category. Reproduced with permission from www.nopolo.se

Concepts covered:

- What they knew about climate change
- Experiences of changes in their environment over time
- Their thought about these changes
- The future for reindeer herding



Fig. 3. The key concepts in the interview guide and the corresponding sub-categories, categories and the emerging theme illustrating the Swedish reindeer herders' perceptions of climate change. Reproduced with permission from www.nopolo.se

was already winter then. By the first Sunday in Advent it was always winter, and snow, and it was cold, and the winter finished around the tenth-fifteenth of May, you couldn't drive a snowmobile any longer. It was always like that. But now the snow doesn't arrive until Christmas, it doesn't go cold, and it sleet and it rains and it browls and goes on in November-December and it's not proper winter and then it's winter until Midsummer instead...

According to the interviewees, the long, stable cold periods often do not occur at all and the **winters feel much warmer**. Sudden thaws in the winter are today commonplace, which can lead to good pasturage becoming locked. In general, the interviewees felt that the winter weather is more unstable than it used to be. They had noted that precipitation can occur even at severely cold temperatures. This completely new and previously unknown phenomenon is quite distressing to the herders.

The **spring comes early and suddenly**, as early as March, 2–3 weeks earlier than normal and the interviewees could see an advantage in this for reindeer herding. Those who have summer pastures in the Norrbotten mountains said, however, that spring in the mountains comes later today or suddenly stops and is followed by a very cold May, which can have a very negative impact on the sensitive calving period. Early spring with high temperatures also means that no proper snow crust forms during the night, making migration more difficult and requiring more energy both from the reindeer and the herders.

The interviewees gave **varying pictures of the summers**. Some felt that the summer season is warmer, whereas others thought the really hot summers have disappeared. Some had noted that in the mountains there are fewer 'nival patches' – patches of snow that remain for longer than the rest of the snow, sometimes even right through the summer – than there used to be. The warmer summers can also bring more insects causing a nuisance for the

reindeer. The interviewees described how the mushrooms arrive earlier, sometimes as early as in July, which means the herders have to finish tagging the calves earlier as the calves begin to disperse in search of mushrooms.

More of everything

Most climate scenarios predict more extreme weather events. None of the interviewees mentioned this but they did talk about the **everyday weather becoming more ‘extreme’, everything is getting more intensive** and they perceived the **weather to be more ‘unstable’**. Sun, rain and snow alternate and the interviewees described how the variations in temperature can be severe, which can lead to rapid changes in pasturage.

The herders perceived the sun to be hotter and to burn more, especially in the spring. The reindeer herders get sunburnt as early as February, something they have not experienced before. When it rains, there are huge amounts of rain; when it snows, it snows intensely.

Herder 13: what I react a lot to is weather that gets so bloody extreme. If the sun starts to shine, it shines incredibly brightly and it’s warm for a long time, and if it starts to rain, it never stops, and if it starts to snow, it never stops snowing either. It gets so, kind of very extreme and I’ve not seen that before, when I was younger.

Herder 5: ‘It’s like this (demonstrates huge waves with the hand) up and down all the time. In recent years, we’ve also started to say that when we’ve had a cold snap of say –15 degrees (°C), that’s been a lot. And we know that it’s now 2 days later and it’s above zero. This is what it’s been like in recent years.’ ... ‘One evening it was suddenly plus two degrees (°C). It went like from –20 to +2 degrees (°C) in just a few hours, but then it went back down again. This kind of uneven temperature is something that you think has started to occur more recently—these sudden shifts in temperature I mean.’

The **tree line is rising rapidly** and the interviewees described how they find tree plants high up on the bare mountain (above the tree line) and that areas that were completely bare before are now afforested. They felt that there has been a general increase in forest growth and they had also noticed that the annual spruce tree shoots have increased substantially in size. The changes have happened rapidly over the last 10 years.

Herder 9: Since I was a kid, you can see quite clearly that there’s now more vegetation. That there are more bushes and more brushwood and that the tree line is moving further and further up. Spruce forest is growing where it actually shouldn’t. And it’s going fast. You can see the annual shoot can be 50 cm on a spruce, for example.

The interviewees were seeing obvious **changes in the vegetation** in the reindeer-grazing lands, which was

something that worried them. Forestry activities have led to a considerable reduction in the occurrence of tree-hanging lichen, but the interviewees also described how reindeer lichen has decreased and has been replaced by grass and other vegetation. Several also said that they believe the lichen is growing more slowly than it used to. They described that denser vegetation with bushes and brushwood are becoming more prevalent.

The traditional knowledge of the reindeer herder has developed over a long time, and many of the interviewees had the impression that this knowledge no longer corresponds with reality, also expressed by elders in their surroundings: **they do not recognise themselves any longer**. New, previously unknown phenomena such as precipitation in severely cold weather and drastic temperature variations over short periods of time are occurring and the old weather signs are no longer reliable. Herders are now being forced to do the opposite of what old, unwritten rules have always said, such as staying out on the mountains all winter or migrating to the summer-grazing lands at the wrong time.

Herder 5: And then we realized that so as not to destroy our winter grazing lands we had to leave, although it was only the end of March. And then we said that our father would turn in his grave if he knew that we were on the mountains at this time of year, it would be unthinkable!

The pressure on reindeer herding is increasing

The reindeer herders described how their room for manoeuvring has constantly decreased over the years as a result of outside pressure and restrictions. The **grazing lands are continuously shrinking**. The lands are being rendered useless for reindeer grazing as a result of exploitation for hydropower, forest roads, logging operations, wind farms, tourist resorts, etc. and no new lands are being made available.

Many Sami villages now move their reindeer by truck in contrast to traditional migration over land, where they herd the reindeer between the summer- and winter-grazing lands by night and let them rest and graze by day. The interviewees described how **migration over land is becoming more difficult** and is even impossible today for certain villages as their migration routes have been blocked by large water reservoirs that either do not freeze over at all or the ice on them is too thin when it is time for autumn migration. For some villages, there is no longer anywhere for the reindeer to graze when en route; the land has perhaps already been grazed or forestry has led to the disappearance of tree-hanging lichen – an important additional source of pasturage. There were several reasons why some herders started to move their reindeer by road, but the changes mentioned here have led herders in some village to realise that they no longer

have another option but to use trucks to transport the animals, despite the high costs involved.

Loss of traditional skills and knowledge worried the interviewees. Shrinking grazing lands and the need for larger reindeer herds in order to survive financially mean that not all those who want to can work as reindeer herders. These people take their skills and knowledge with them into other industries. In villages where traditional land-based migration is no longer possible, the new generation will never learn how to herd reindeer en route and traditional knowledge will be lost forever.

Herders described how the number and extent of **competing business activities are increasing** all the time and how the reindeer industry must always take a back seat in favour of interests from other industries such as wind power, hydropower, mining, forestry and tourism. They have neither the time nor the energy to spend working on all these issues.

Activities in the mountains and in the forest are expanding all the time and cover an increasingly greater part of the calendar year. According to the interviewees, this has led to the **reindeer being disturbed for much more of the year** than before by hunters, snowmobile enthusiasts, recreational activities, skiers, hikers, adventure tourists, etc. More and more activities are being offered to more and more tourists in the mountains, exerting greater pressure on the reindeer industry. The herders felt that everyone should have access to the mountains but they asked for greater respect from the general public for the needs of the reindeer and felt that this should be regulated in some way.

The interviewees emphasised the **poor financial conditions** for reindeer herding and the fact that they are nowadays totally dependent on state subsidies for their livelihoods. Examples of such subsidies include those for supplementary feeding, predator compensation and slaughter support. The reindeer industry is finding it difficult to survive financially on its own, and the vast majority of herders need to have another job on the side. The interviewees saw the poor financial prerequisites as yet another threat to regeneration among reindeer herders as today's youth are not attracted to an industry in such dire financial straits.

The **predator policy was seen as a major threat** by the interviewees and a cause of a great deal of worry, anguish and sorrow. According to the reindeer herders, the predator compensation nowhere near covers the costs incurred by Sami villages when predators attack their animals, and they were convinced that the threat posed by predators has increased considerably over the last 20 years or so. Predators also cause the herders a great deal of mental stress. They feel for their animals and suffer when they find their remains, not only because of the financial loss they incur but also because they know all the individual animals in the herd and their histories.

The interviewees described how intermittent grazing by dispersed herds and the absence of deep snow favour the predators as this makes it easier for them to move around and attack their prey. They said that the reindeer industry will not be able to withstand the even greater pressure from predators that the climatic changes may create. The interviewees felt that the current Swedish predator policy does not consider the reindeer industry at all and that the general public is more or less ignorant of the facts.

As the financial situation deteriorates for the reindeer industry, all herders must have larger herds. With large herds and constantly shrinking grazing lands, the pasturage is being grazed too intensively and has too little time to recover. The interviewees perceived a **lack of sustainability in today's reindeer-herding activities**, and they ascertained that they also had contributed to this development by starting to use trucks, helicopters, snowmobiles and motorbikes to a greater extent, which is very expensive and leads to costs that the industry is finding difficult to bear.

The reindeer herders pointed out that the poor and patchy pasturage is very labour intensive as the dispersed reindeers have to be more intensely watched and herded together more often. There is a need for supplementary feeding almost every winter. Today's large herds in combination with the scattered pasturage make it virtually impossible to herd reindeer without the use of snowmobiles, and the interviewees ascertained that the reindeer herders' **traditional methods are not compatible with today's climate**.

Herder 8: And then I can think about past winters. It wouldn't have been possible to use skis to keep the reindeer herd together.

Using snowmobiles is costly and is, according to some interviewees, detrimental to the reindeer herders' health, causing work-related musculoskeletal disorders and pain. The interviewees also said that the climate change predictions they have received from researchers and authorities have caused considerable mental stress among herders. The **predictions have been difficult to contend with** and having them confirmed on a daily basis has further contributed to the stress and worry about the future, perhaps even more than the changes themselves.

Constantly left out in the cold

The herders described how the reindeer-herding Sami have always had to adapt and yield to a number of decisions taken by the authorities. They pointed out that the mountains were originally the Sami's own country, where they were completely alone. When other interests in utilising this land emerged, the government intervened and claimed it as its own and the Sami had no say in the matter. The herders interviewed felt that the Sami were basically 'steamrolled' when the Reindeer Grazing

Convention came into force in 1972. The introduction of the 1993 law on hunting for small prey is seen as a similar decision that was taken without their consent and conflicted with their views and interests. Feelings of **resignation and powerlessness in the face of authorities' decisions** and the regulatory framework were expressed during the interviews. The interviewees felt that they were being ignored and that they had no say in the decision making.

Herder 6: And I remember we really took the gloves off when we were negotiating about the 1972 convention but we still got shafted. However much we objected, we were just brushed aside.

The interviewees expressed that **reindeer herding has always been 'up against it'**, and that the value generated by the reindeer industry counts for little in comparison to the ready cash produced by other industrial sectors: that **reindeer herding is not valued** in Sweden today, not considered important.

The interviewees were aware that, as a land-based industry, theirs is vulnerable to the effects of climate change and they felt that **they are the first to be affected**. They didn't feel, however, that Sweden is participating in research into climate change and its effects on reindeer herding as actively as the other countries in the Arctic region. The interviewees called for a more active approach to research and more powerful measures to combat climate change. They believe that the government only proposes detailed measures and these also affect the reindeer industry. The increased taxes on fuel prices, for example, is making snowmobile and truck transport much more expensive and is having a serious financial impact on the industry, according to the study herders.

The interviewees painted a picture of **the individual having great responsibility** in the Sami reindeer-herding collective. Many herders are trying to be active and to take responsibility for their own livelihood and existence, for example, using less motorised vehicles, avoiding helicopter herding, taking better care of their waste and using ecological fuel. But, some of the interviewees nevertheless felt that they should get more involved in what is happening in the world around them, protest more against the encroachment by others into the environment on which they depend. At the same time, the interviewees felt that they do not have the time and this gives rise to a feeling of resignation. They felt the fact that they are 'first in the firing line' of climate change is unjust as the reindeer herders themselves don't think they have contributed to it as much as others have. The interviewees felt that society in general should be assuming a greater level of responsibility for the costs associated with climate change.

According to the study herders, the Sami consider themselves a peaceful people and throughout history they

have **always adapted and backed down**, not taken issue and protested – a strategy they are now starting to perhaps regret.

The Chernobyl nuclear disaster in 1986 hit the reindeer industry hard and constituted an elusive and invisible threat. The interviewees described feelings of being alone, powerless and left to fend for themselves after what happened and they had to deal with the problems caused by other people. Several of the herders spontaneously referred to Chernobyl when talking about climate change.

Herder 9: Look at Chernobyl for instance. Overnight things could change so much and affect so many people. So we've always got that in the back of our minds. And it's not certain . . . that we'll be able to still herd reindeer in fifty years time.

Chernobyl brought sorrow. According to those interviewed, herders had to go against their own values in terms of the respect they have for all living things. Everything changed overnight; apparently healthy animals were slaughtered and the meat had to be discarded. All Sami villages were adversely affected by the drop in demand for reindeer meat, but only villages with extremely high radiation levels in their meat received compensation.

The accident illustrated just how vulnerable reindeer herding is and with **Chernobyl still fresh in memory**, the interviewees expressed no faith in the governments' support in terms of climate change impacts on the reindeer-herding industry.

Changing without losing the identity

Throughout the interviews, there is a sense of **grief for the future**. The herders did not consider **climate change** in itself to be the major threat to reindeer herding but rather to be **yet another stressor** on an already heavily burdened industry and culture. The interviewees described **how fantastic their work as reindeer herders was**, with a high quality of life. But, they also talked about reindeer herding as **hard work, with a lot of worries and anguish** as well. These worries focused primarily on the toll of predators on the herd, the weather, the availability of pasturage and the general financial considerations of the occupation. Several of the interviewees expressed relief at the thought of retiring. The **pressure to be positive** and always look for opportunities in order to have the strength to carry on with the job clearly came out in the interviews.

The interviewees emphasised that that they have always been able to adapt before, that they have to think of new solutions, a different form of reindeer herding, perhaps start to feed the animals, utilise new grazing land, etc. They think they can see **opportunities in climate change**, not just threats. If climate change results, for example, in snow-free winters, this would be a good thing for the reindeer industry. An extended growing season may

provide the reindeer with better pasturage during the summer and they would be able to survive more serious winters, if they were shorter than they are today. Despite the interviewees talking a lot about the obstacles and difficulties caused by climate change, they also emphasised their own local benefits in the form of undulating grazing lands, access to nature reserves, better winter pasturage than other villages, etc.

One of the interviewees talked about a feeling of relief at not having had any children because of the stress and worry one suffers as a reindeer herder.

Herder 5: The fact that I don't have any children, I see as an advantage in certain situations, honestly, when I think of what's ahead . . .

Several of the interviewed herders have children who want to continue herding reindeer and they try to take a positive outlook so as not to destroy their children's hopes for the future.

Herder 9: The future of reindeer herding, yes, I hope it'll survive. And I have youngsters who believe in it. And I try to think positive for their sake as well. And for my own sake. But that's the thing; I can't be negative and pessimistic because then I'd undermine their hopes, beliefs and future prospects. Yes, so you just have to grin and bear it.

The interviewees described how **they want to believe in the future for reindeer herding but** at the same time they could see that it has already gone through major changes and that the adjustments needed to combat climate change in the future risk becoming overwhelming when combined with all the other stressors. They described how motorisation, profit maximisation, unsustainable grazing and feeding are all unwelcome developments and that a resistance movement has begun where herders are **trying to revert to more traditional methods**. However, this has been made more difficult by the climate changes on the environment.

Supplementary feeding is a reluctant emergency solution that has recently become necessary almost every winter because of frozen pasturage. Even though the interviewees did not like the idea of feeding, they were grateful that the option is available to them as their historical emergency pasturage in the form of tree-hanging lichen has now virtually disappeared. **Supplementary feeding is costly**, and the interviewees also described many other problems and difficulties it causes, including poorer tasting meat, a different fat consistency in the meat and a different and heavier workload with more herd supervision and feed management, compared to free grazing. Financial subsidies also come up in this context, the herders pointed out the **risk of fenced reindeer gaining a competitive advantage** over traditional reindeer herding: the reindeer do not need to be monitored, the costs for snowmobiles and motorbikes are avoided, the animals do

not need to be transported and fed reindeer are bigger and weigh more when they are slaughtered. All the interviewees were against the trend towards keeping reindeer in enclosures, which, they said, increases the risk of disease among the animals and is against their nature. The interviewees described how the greater need for feeding, the trend towards keeping reindeer in enclosures and the hopeless financial conditions for reindeer herding are threatening the very professional identity of reindeer herders. Thus, the profession of herding is at risk of becoming just a hobby. **In the past, the reindeers were the focal point** of reindeer herding; the reindeer steers what the herder does, not the other way round. However, the interviewees described how **the profession is today more and more governed by outside circumstances** instead of by the reindeer. For example, the animals are slaughtered when the herder manages to book an abattoir truck or on the day the vet is available. Herders make sure they do not arrive in the mountains until after Easter so that they do not have to ask for a ban on snowmobiles and come into conflict with tourists. The herders must move the animals when they can get hold of a truck, etc.

Herder 9: You are controlled in a different way by dates, like when we get the abattoir truck. We're a bit controlled from the outside as well. You can't just decide that now we'll take the reindeer in when the timing and conditions are ultimate.

The interviewees described the **difficulties in combining traditional reindeer herding with today's society**: reindeer herders and their families also want to go on holiday, the children want the same material standards as their friends, value is seen only in terms of ready money. The interviewees found it difficult to see how the reindeer industry can bear such costs with the conditions it faces today, and several could not see a solution to the problem and asked themselves whether they are **the last generation of traditional reindeer herders**.

Discussion

The core theme that emerged during the analysis was 'facing the limit of resilience'. In resilience theory, the concept of resilience refers to the capacity of a system to absorb disturbance and reorganise while undergoing change, so as to retain essentially the same function, structure, identity and feedback (13). The categories in this study are examples of such disturbances. Climate change poses additional challenges, and the reindeer herders no longer believe in their ability to adapt, leading towards the limit of resilience.

A lack of control is apparent in the whole data set. Most of the study reindeer herders have actual experiences of vulnerability directly connected to nature by living through the impacts of the Chernobyl accident. The interviewees described these events with strong

feelings of vulnerability, exposure and resignation; emotions increased by the dependency on decisions made by others. These experiences seem to affect how the reindeer herders view and handle the future and the prospects of climate change as described by the categories: grief for the future, trying to revert back to more traditional methods and being the last generation.

The study interviewees' experiences of delayed autumns, bodies of water freezing over later in the year than usual, warmer winters, earlier springs, rising tree levels and changes in vegetation are all changes reported and/or predicted in the Intergovernmental Panel on Climate Change (IPCC) climate change assessments (1). In the Snowchange project 2001–2004, indigenous voices of climate and ecological change from all over the circumpolar North were heard and their statements also confer with the ones in this study (14). The reindeer herders in this study described both earlier spring and also longer lasting snow cover depending on location, giving the impression of later spring. These reports could be conceived as a contradiction, but this scenario has been described as a possible climate change impact by Høgda et al. (15). They posited that the impact of climate warming might result in an earlier onset of spring in areas where snow cover has been blown away by stronger winds, whereas spring will come later in areas with a thicker snow cover where the snowmelt will take longer (15).

A greater variability in the climate in form of more frequent storms or other extreme weather events has also been predicted (16). Although more extreme and unstable daily weather has not been identified in the projections, the reindeer herders in this study emphasise those phenomena. Whether these daily phenomena represent a so far unknown feature of climate change effects on weather systems remain unclear, future research is required to be able to make this determination.

Russian reindeer herders, the Nenets, as reported by the anthropologist Stammeler-Gossman, share the Sami reindeer herders' concern about limitations in the adaptive capacity to handle climate change. Stammeler-Gossman claimed that for the Russian Nenets 'changes to the natural environment induced by human activities are seen by the community as the main disturbing factor, whereas changes due to the "natural course of nature" may be accepted in the broader context of the autonomy and self-organization of nature' (17). From the present study, it is not possible to say whether the Swedish reindeer herders share this cultural acceptance for natural environmental changes, but if they do, it could explain their lack of reports of more extreme weather events. Extreme weather events such as storms and flooding would then be considered a natural part of nature, as opposed to more extreme daily weather such as rapid fluctuations in temperature. Reindeer herders, in Sweden as well as in Russia, are experts in adapting to a dynamic

landscape and changes in weather and environmental factors. This capacity for adaptation is based on traditional skills and knowledge and when this knowledge is no longer applicable or valid, it adds a new dimension of insecurity.

The Swedish reindeer herders in the present study are less concerned about the issues caused by climate change, but much more about their ability to adapt to those changes because of several other stressors and limitations. The interviewees argue that nature always changes and that they can handle climate change effects providing they have the means to do it. In the present study, issues such as decreasing grazing lands, poor economy, competing businesses and the Swedish national predator policy stand out as major threats to the adaptive capacity of reindeer herding.

The IPCC's third assessment report defines vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects or stress (16). Many of the contemporary additional concerns for Arctic indigenous peoples, such as poverty, substance abuse, inadequate housing and substandard infrastructure, are not valid for reindeer herders in Sweden (2). Even so, based on the results in this study, Swedish reindeer herders are, according to the IPCC's definition, highly vulnerable to climate change effects.

In Sweden's 1994 national report to the IPCC, the evaluation of vulnerability to climate change includes only a few words about reindeer herding, mentioning larger quantities of snow, the formation of 'ice bark' and increased vulnerability to traffic death of reindeer, as problems. In comparison, the section about fishing is 3.6 times longer, although there are fewer professional fishermen than reindeer herders in Sweden today (18, 19). In the second report from 1997, there is no evaluation of vulnerability for reindeer herding (20). This might reflect the interviewees' experiences of not being recognised in the Swedish society.

The Swedish Sami reindeer herders share their grief for the future and their fear of being the last generation to carry on traditional occupations such as reindeer herding, with many other indigenous peoples over the world. According to the UN, indigenous peoples face systemic discrimination and exclusion from political and economic power in many places of the world and the interviewees in this study describe the same notion.

Keskitalo's comprehensive work on vulnerability assessments in the Arctic focusing on several nature-based industries also includes interviews with three Swedish reindeer herders and these participants likewise emphasized that the operating conditions for the sector must be improved to enable adaptation to further changes. Keskitalo summarised the sectors' vulnerability as the result of multiple factors such as a poorly developed market, national regulation, climate/weather conditions

and limited recruitment into the livelihood due to declining income (21). The Keskitalo participants, interviewed in 2004, also brought up that they were close to the limit of adaptation. This study, performed 5 years later, suggests that the reindeer herders are now even closer to that limit: in the light of climate change, they are facing the limit of resilience.

Conclusion

The results of this study illustrate the reindeer herders' vulnerable situation. The climate change impacts add additional pressure on the reindeer-herding industry that might have detrimental consequences for the trade, the culture, the historical traditions and the people involved. Swedish decision makers on a national level, as well as regional and local levels, need to have an increased insight into the various pressures affecting the reindeer-herding industry to be able to make adequate decisions on climate change adaptation strategies. This article provides a framework for improved decision making based on the reindeer herders' own perceptions and experiences.

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