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WARMING SCIENCESCAPES IN INARI, FINLAND

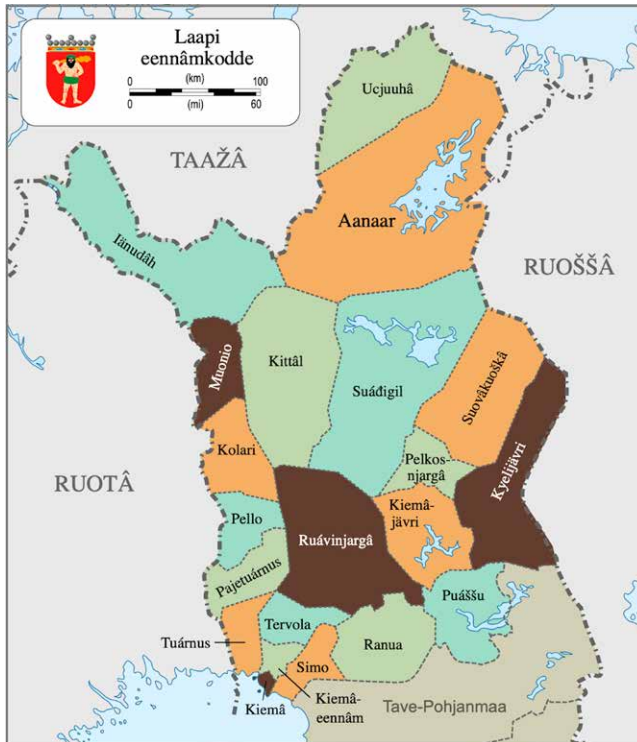
– the competing futures of forests, pastures, and reindeer during climate change

This paper asks, how research has produced prognostic narratives on sub-arctic forest ecosystem? Inari, located in the Sámi homeland, has been a site for recurring conflicts between reindeer herders and foresters over usage of the forests. Research has contributed to the dispute by producing prognoses of ecological trends in forests/pastures. The need for solutions has become more compelling as changes induced by climate change have grown in number and severity. A siloed production of knowledge is evident, where each research cluster advances technical or traditionalist future-oriented practices as solutions to the accumulating problems.



Introduction – Making prognoses of pasture and forest condition and use during climate change

In this article, I will discuss what kind of prognoses climate change related research has produced on the forests and pastures in Inari. In the research, prognoses of future conditions for forests and pastures are shaped by and influence current discussions of how the future climate will shape the practices of forestry and reindeer herding. The areas studied are in simultaneous use as forest pastures for reindeer herders and as a resource for timber. I have studied prognoses as performative narratives in the sense



Map of Lapland, in Aanaar Sámi, a threatened language.

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that they are intended to influence the future uses of the forests/pastures. This study is embedded in four contexts.

Firstly, a distinctive feature in Upper Lapland is the recurring and long-lasting disputes over resource and land use, which are centered in the municipality of Inari.¹ *Inari* is a municipality in northernmost Lapland, in the Sámi homeland.² Inari has unique timberline forests, which comprise an ecotone between the northern boreal forest zone and the tundra, which are a resource both for the reindeer as pastures and the forester e.g. as a source of employment. The main reason for the disputes has been the overlapping resource zones of reindeer herding and forestry, the latter having a history of intensifying loggings from the beginning of the 20th century until about the 1990s. Neither the means of living nor the conflicts follow ethnic boundaries, the fronts have been re-formed many times, and the actors involved have ranged from local to global.³ Since the introduction of Forest Law in 1886, the land and forests are administered by Forest and Park Service (FPS), a state organization, which is nowadays mostly concerned with “nature services”, i.e. tourism. Inari is a multi-ethnic municipality, populated by majority Finns and three Sámi groups distinguished, for

1 Raitio 2008, p. 81.

2 The term Sámi homeland refers to the area, where the Sámi practice cultural autonomy, according to the Law on Sámi Parliament. The area consists of municipalities of Enontekiö, Inari and Utsjoki, as well as the reindeer herding cooperative Lappi in Sodankylä. [Saamelaiskäräjät | Saamelaiskäräjät \(samediggi.fi\)](#), read 1.9.2024.

3 Finns have the right to practice reindeer herding and there have been Sámi on the payroll of the FPS. Nyssönen 2007, passim.

example, by their languages: Northern Sámi, Aanaar Sámi and Skolt Sámi.⁴ In Finland, the Sámi enjoy constitutional self-government and the status of an Indigenous People; Inari houses the localities of the self-governing organ, the Sámi Parliament.

Secondly, the forest times of Inari are special in a Finnish context. Everything takes a longer time: the growth of Lapland's forests is slow, which is why the expected and actual outputs, both natural and economic, remain small. Harsh climatic conditions, large areas and long transport distances weaken the profitability of forestry. Due to the slow pace of growth, stands under natural renewal are given more time (25 years instead of 20 years) for saplings to reach an acceptable seedling density and sufficient height.⁵ People's use of time in Inari has been based to varying degrees on the cycles of the forest ecosystem: the working years are scheduled according to the work phases of forestry and the growth in forest stands, the movement and nutritional needs of reindeer, weather and snow conditions, and increasingly the high seasons of the tourist industry, for which the forest is a resource for staged experiences.⁶

Thirdly, *climate change* has changed on a temporal scale from a prognosis, a threat somewhere in the future, to an ongoing change in the present.⁷ In Finland, temperatures have risen about two degrees since the 1880s; in the Arctic in general, temperatures rise three times faster than on average globally.⁸ This affects both reindeer husbandry cultures and the areas they use, as well as forestry because vegetation zones change their location globally and their quality locally.⁹ This is a large-scale "wicked problem", which is exceptionally complex due to intertwined causes and effects, as well as uncertainty and disagreement about solutions. While climate change has prompted a reappraisal of political goals, it has also provoked polarized reactions and opposition, due to the different agendas and priorities of interest groups, as well as the uneven distribution of concessions, sacrifices and opportunities to different interest groups.¹⁰

Fourthly, *knowledge production* on the effects of climate change has increased tremendously in volume since the turn of the 21st century. According to Sverker Sörlin, research is a central field, but not the only one, in which new futures are defined and shaped.¹¹ Economically-oriented forest research is interested in the historical, statisti-

4 The Sámi reside in Finland, Sweden, Norway and Russia. The current total population is estimated to be approx. 70,000–100,000. The Sámi are the only folk enjoying the status of Indigenous people within the EU. The Sámi speak nine surviving languages and practise versatile sources of subsistence. A significant minority is engaged in reindeer herding. See e.g. Lehtola 2002, p. 9ff.

5 Hallikainen et al. 2020, p. 24.

6 Varanka 2001, p. 85ff.

7 Wormbs 2018, p. 1ff; Hannukkala 2001, passim.

8 [Ilmastonmuutos \(arcticcentre.org\)](https://arcticcentre.org/); [Ilmastonmuutos näkyy jo Suomen luonnossa \(ymparisto.fi\)](https://ymparisto.fi/). Both accessed 26.6.2024.

9 Norokorpi 2009, p. 33; Jaakkola, Näkkäläjärvi and Juntunen 2020, passim; Horstkotte et al. 2017, passim; Berner and Goetz 2022, passim; Mathiesen 2023, p. 1-2; Tonkopeeva et al. 2023, p. 26

10 Head 2022, p. 95-98; Bulkeley and Newell 2015, p. 94-99.

11 Sörlin, electronic source, accessed 08.09.2023; Wormbs 2018, 7-8.

cal and expected growth, and the pace of growth, of forests. The branch of science has been involved in regulation of the degree and direction of forest ecosystem change, which has affected the pace and manner of growth, as well as the age group structure in which temporalities are visible. Thus, forest science is one of the tools through which time scales are changing in the forests. In addition, biological and ecological research has shown how the forest ecosystem's cyclical changes function at their own pace and at different speed. This includes competition between different plant species in time and space, nutrient cycles, annual cycles and multi-century tree renewal cycles. The long-term geological changes regulate the geochemical properties of the soil, and the nutrient and growth base of plants.¹² The interaction of different temporalities and the influence of forest time on human activities and times can be seen, for example, in agriculture and natural livelihoods, which are studied in the field of human sciences, making visible the futures envisioned and narrated, and practiced in the mentioned livelihoods.¹³ As such, the forests of Inari are thick with both past, present and futures.

The tangible consequences of climate change have called for prognoses of detected trends in the ecosystem. Within science prognoses are always made from a scientifically, socially or morally determined point of view; they may directly serve some interest groups and supersede the interests of others.¹⁴ Research on forest use in Upper Lapland has been conducted and used for a long time to defend and oppose different forms of use.¹⁵ Nowadays, segments of Sámi research are conducted from the perspective of the needs of the Sámi communities, a position taken with pride.¹⁶ Generally, research allows and denies a voice to different interest groups and groups of actors, either through deliberate policies or simply by the delimitation of the groups of actors and the categories studied.¹⁷ Often the persistent belief in objectivity in quantitative natural sciences marginalizes alternative categories and systems of knowledge.¹⁸ In addition, prioritizing environmental values or nature in research marginalizes the ecologies of some groups of actors, potentially also those of Indigenous Peoples.¹⁹ All this affect the direction and delimitation of prognoses.

Scientific prognoses promise a degree a certainty, while at the same time being contingent, uncertain, dependent on source material and the chosen method, and on politics. There are no deterministic laws to be found, while risks and probabilities apply. In this sense, prediction has an interpretative element to it, where the statistical

12 Norokorpi 2020, 40–42, 46; Sarala et al. 2009, 34–37; Sörlin, electronic source, accessed 08.09.2023.

13 For example, Ruotsala 2002, *passim*.

14 Compare Fritz and Binder 2020, *passim*.

15 For example, Veijola 1998, *passim*.

16 For example, Kuokkanen 2023, *passim*; Stordahl 2008, *passim*.

17 Fritz & Binder 2020, p. 3 ff.

18 Wormbs 2018, pp 7–8; see Diver 2017, *passim*.

19 Sjölander-Lindqvist 2022, p. 7.

“certainty” has to be narrated.²⁰ However, prognoses made in the context of research are more reflective than many other mundane visions of the future. The scholarly activity is embedded in scientific discourse, as they adhere to the rules therein and take part in its formation by producing replies to the internal scientific discussion. In the context of research, prognoses have gone through scientific, interdisciplinary, (ethno-)political and economic considerations.

Narratives, performativity and the future of forests in Inari

This article builds on theorizing about the simultaneity of dimensions of historical time. In this field, Reinhart Koselleck’s work was ground-breaking. Koselleck perceived the concept of experience and expectations (*Erfahrung und Erwartung*) as a way of being in the world. This pair of concepts reveals how history is not just the past: attention is drawn to the connection between the past and futures, which are visible in the memories, hopes and scenarios of the actors. Like experience, expectations “happen” in the present.²¹

Since Koselleck, theorizing on the simultaneity of past, present and future has been ample, concentrating especially on the ways in which the past is present in the present, in protected cultural traditions, layers of material survivals, physical structures used by livelihoods, in landscapes and memories.²² For my study, however, I am interested in what Niklas Luhmann has defined as “present future”, i.e. futures imagined in the present. These are a complex collection of expectations which help give meaning to current phenomena and the basis on which choices about the future are made. These futures are present in the now, presenting themselves as horizons of expectation and fantasies; unrealized, “not yet” futures which determine the present situation as well. In this way, they are performative, and they attempt to influence societal debates and conflicts.²³ For my purpose, I focus on prognoses made on research, which I study as performative predictions of the future, based on observed trends and given the textual form of a prognostic narrative.²⁴

By narratives I mean an intentional action, which has both a textual and a social dimension. Narratives create and communicate a programmatic meaning to the text via a story or, in this case, prognoses produced by authors and scholars.²⁵ Scientific texts might not be the most obvious genre geared to narrative reading, but they nonetheless adhere to the minimum criterion of a narrative: in order to be com-

20 Siponen and Klaavuniemi 2021, *passim*.

21 Koselleck [1979] 2004, p. 261-263.

22 See for example Bevernage and Lorenz 2013, *passim*.

23 Jedlowski 2019, p. 488; Wormbs 2018, p. 2; Luhmann 1976, *passim*.

24 See for example Rasmus et al. 2020, *passim*.

25 Currie 2012, p. 6ff.

municative, narrative has to be organized along the lines of succession in time, i.e. be structured along the traditional linear temporalities. This succession is as crucial factor in causation in science as it is in the production of narratives. It is in the configurative elements in texts, which organize separate elements of the text into a cohesive and meaningful entity that narratives appear. These may be points of view, ideas or principles, which frame and limit the relevant, selected conditions under which is possible to narrate this meaning. Conceptual capacities, resources for knowing, ways of reasoning, morals and values limit the point of view, and the resulting narrative among the scholars as well, including its potential reception.²⁶ These biases or limitations to knowledge become detectable in explaining (environmental) change. Is the expected prognosis one of efflorescence, an increase in biodiversity, an improvement in resource bases, or the opposite – unwanted, diminishing, threatening?

In a similar manner to prognoses, narratives possess the potential to do something beyond their mere literary form.²⁷ Narratives also construct the different actors, stakeholders and interest-holders and their position within the text, landscape and ecosystem.²⁸ To exemplify, I study the way that reindeer (*Rangifer tarandus*) are positioned, in a meaning-creating and narrative-bearing manner, to the scholarly production. Socially, narratives are crucial for social mobilization and for new political solutions. Narratives have been seen to enable policy change by communicatively creating novel connections which transcend established spatial, social and political divisions, and include social as well as ecological processes.²⁹ However, prognostic narratives may fail in building new connections as well, which will be the case in the study at hand. This performative dimension of narratives is detectable in the preferred solutions provided to the problems connected with changes in ecosystems. Besides the orientation to, or location in the future, these solutions can possess complex politics of orientation in time; they can be traditionalist, conservative-industrial, or build on ecological solutions not tried before.

The focus of this article is not Sámi culture, nor traditional ecological knowledge (TEK) as such, a politicized and versatile issue, and something that the research material studied here has dealt with only in passing, implicitly or instrumentally. The focus is how the TEK is mobilized in scientific discourse and in prognoses, and how the scholars position reindeer in the future pastures. This predicting and narrating takes place in open, public research discourses. The research ethical stance then is to include all the scholarly voices in the inquiry, so that Sámi counter-narratives are studied as well.

26 Currie 2012, p. 86-93; Heiret, Ryymin and Skålevåg 2013, p. 19-27.

27 Heiret, Ryymin and Skålevåg 2013, p. 28.

28 Heiret, Ryymin and Skålevåg 2013, p. 27; Nyssönen 2023, passim.

29 Leipold et al 2019, p. 455.

Empirically, I have selected research on forest ecology and forestry, reindeer husbandry and pasture ecology research, and climate change research. All these disciplines contribute to the production of prognoses, through commenting on each other and penetrating each other's research areas. The research funding on these urgent matters has been generous, which is visible in the huge volume of published research: The search "Climate change Inari" in Google scholar resulted in 574 hits for the years 2023-2024 alone.³⁰ Therefore, the sample gathered for this occasion (N=36) does not come close to being exhaustive. I chose the articles on the basis of the date of publication, from approx. the late 2000s onwards, as this collided with tangible effects of climate change. The second aspect was the ecosystem studied, in this case the subarctic forest. The third factor was the theme, I focused on articles which discussed the different usages of this ecosystem. Moreover, I limited the analyzed literature geographically and on research theme, rather than concentrating on specific journals. However, I chose only peer-reviewed, scientific articles and review articles, mostly from international journals. The geographical scope of this study means that the articles were primarily written by authors associated with universities, research centres and institutions of the Nordic north (e.g. Arctic Centre, University of Lapland, UiT – The Arctic University of Norway, Umeå University). The sample turned out to be sufficient as different policies, biases and narratives were unveiled from the sources. Discipline-specific traits also surfaced, pointing to "siloeed" research interests and policies.

I have used the studies as primary sources, actively looking for how possible futures were calculated and envisioned as a politicized field. My analysis focuses on both prognoses themselves and the proposed solutions to climate change. Thus, I see them as performative, future-oriented, prognostic narratives which seek to influence human activity in relation to forests and forest time. Narratives both limit and produce these prognoses, by defining which activities will be prioritized and/or ruled out in the desirable futures of the forests of the North. Methodologically, I engage in a narrative reading, trying to find the emphases and exclusions contained in the prognoses. To do so, I have worked from the following questions: What kinds of futures are imagined for forests and livelihoods using them in competing forest prognoses? Which solutions have been proposed for the problems created by climate change? In which ways are reindeer positioned in the prognostic narratives? Are the resources gathered under a common threat, or are prognoses still competing?

30 Climate Change Inari (Google Scholar). Accessed 14.9.2024.

From brightening prognoses to societal challenges – prognoses and solutions in forestry research

In the following, I chart the changes in prognoses made in forestry research. In the first phase of observations, forestry scientists (9 texts in the sample) perceived climate change to have positive effects on forestry. The promise of increased forest volume, cherished by efficient forestry thinking, seems to have been fulfilled in the 2000s, when the growth of Lapland's forests was noticed to have increased by almost 50% in a couple of decades. In addition to climate change, however, the reason for the increase in the total number of trees is the low amount of felling: the growth of biomass of wood is concentrated in young forests which have not yet been felled. The change is also due to more favourable temperature conditions, an increase in the amount of carbon dioxide and nitrogen deposition.³¹ Forestry scientists forecasted Lapland being filled with wood biomass and "bushes". As this signifies underutilization of the timber producing capacities of the forest ecosystem and resources, several foresters detest the idea. The expansion of market areas due to globalization fuelled optimism and the economic sustainability of the sector was seen as guaranteed.

On the other hand, what was once exploitable commercial forest was becoming Europe's last wilderness, the cycles and times of which should not be interfered with. The land rights claims by the Sámi created pressures and disturbances, which already extended to forests, as well as by conservation initiatives, which the forestry scientists especially feared would displace forestry in Upper Lapland. Scientists understood climate change through a similar duality: it was both a factor that accelerate forest growth and as an uncertainty factor and threat, due to extreme weather.³² Later, the possibility of collapse-like disruptions to forestry in conditions of climate change was stressed. Warmer and longer growing seasons also involve increased risks: extreme weather, damage caused by new pests and increased forest fires threaten forest growth and forestry. Harvesting trees in winter is likely to become more difficult as the freezing of the terrain is inhibited.³³

The prognoses vary in their pessimism: if forestry continues at its current efficiency, lichen pastures will decrease, or the implementation of forest management taking reindeer husbandry into account will lead to decreasing harvesting volumes, employment effects and profits, but also greater forest cover, greater carbon sequestration and better opportunities for reindeer husbandry.³⁴

Currently, forestry researchers are positive about forest management, which also takes forest time into account; its potential to succeed in the difficult task of securing the growth of lichen cover and forest regeneration is considered greater than in the

31 Stark et al. 2023, *passim*.

32 Varmola 2001, *passim*.

33 Turunen et al. 2020, *passim*.

34 Turunen et al. 2020, *passim*.



Tourism is the third means of living, which uses the forests of Inari as a resource. A hiker has captured a river and forest scene on the River Lotta, in the midnight sun.

Image: Wikimedia Commons, Creative Commons License CC BY 3.0.

efficient forestry model.³⁵ The operating environment has changed, to which the forest sector has already reacted, but the reindeer is mostly absent from the prognoses. It is considered at worst a hindrance to (rational) forestry. This old prognostic narrative of industrial growth is challenged by a more cooperative narrative of the co-prosperity of interest groups and efflorescence of pastures/forests. The narrative shows a willingness to include the reindeer among the factors to be taken into account in forestry planning, where the rationale is still to secure a continuation of harvesting timber.

In Inari, forestry was already retreating before climate change appeared in the forest debate. Following the failure to introduce efficient forestry in Inari, the old forest has replaced the “economic forest” as an ideal, because of its intrinsic value for conservationists, and/or good winter pasture for reindeer herders. Forestry professionals had to adjust their expectations on several occasions as unexpected changes in the opinion climate and, eventually, national discourses overwhelmed forest management plans.³⁶ In Inari, lost opportunities and unrealized expectations materialized in the form of an abandonment of forest stand plans, periods of unemployment in conditions of reduced felling volumes and, finally, the reorientation of the entire administrative structure towards “nature services” for tourists.³⁷ Forestry and its planning continue in Inari, but loggings have been scaled down. That forestry has had to give

35 Horstkotte et al. 2022, p. 90.

36 Koselleck [1979] 2004, p. 261.

37 Turunen et al. 2020, *passim*.

way to reindeer husbandry interests, has had a negative impact on the profitability of the FPS's forestry operations.³⁸

Thus, the industrial thrust of the prognostic narratives in forestry science match the lived reality in Inari only partially, as the prognoses of increasing pressure from “disturbances” – nature conservation and the Sámi movement – have materialized. In addition, e.g. mining companies have begun to buy conserved areas in Inari as compensation for activities elsewhere.³⁹ The performative aims of the forest science narratives are no longer reached in Inari. In the prognostic narratives made on the futures of herding, the initial positiveness was weaker, as climate change hit a means of living already in perceived crisis.

Darkening prognoses in pasture and reindeer husbandry research as climate, forest/pasture ecology and spatio-temporal cycles change

For a long time, prognoses in reindeer husbandry and pasture ecology research (23 texts in the sample⁴⁰) have been growing more pessimistic. The future is envisioned through the challenges which this trade encounters.⁴¹ Scientists present reindeer herding as vulnerable, in need of security and protection.⁴² The main prognostic narrative of reindeer husbandry research and Sámi politics is one of a livelihood and endangered culture struggling with a declining pasture areal. Large segments of the research community reproduce the narrative of the fragmentation and reduction of pastureland by the tourism industry, green energy, infrastructure projects and mining that is repeated by the Sámi politicians and activists.⁴³ Thus, horizons of expectation are weighed down by the continuous, cumulative threats of competing livelihoods: forestry is presented in international and Sámi reindeer husbandry research as one of the external forms of land use which dramatically weaken the grazing resources and future prospects of reindeer husbandry. The accumulated impact can be seen in the growth of emotional disturbances among reindeer herders and pessimistic perceptions of the future prospects of the livelihood.⁴⁴ Aside from light forest regeneration methods that would have a short- or medium-term positive effect on reindeer

38 Turunen et al. 2020, passim.

39 Elonen, Piia 2024: ”Erämaa ei kelvannut valtiolle suojeltavaksi: Brittiläinen kaivosjättilä osti ja suojeli”. *Helsingin sanomat*, 16. September.

40 Almost all the texts considered some aspect of climate change effects, but only four texts concentrated on climate change alone.

41 Olsén et al 2017, passim.

42 Itkonen 2019, passim.

43 E.g. Kuokkanen 2023, passim.

44 Stark et al. 2023, passim; Tonkopeeva et al. 2023, p. 26; Landauer et al. 2021, passim; Moen et al. 2020, p. 271.

husbandry, scholars have rejected the old idea that forestry is favourable to reindeer husbandry.⁴⁵ The relationship between forestry and reindeer husbandry is still tense, although the participatory planning and lighter forest management methods presented by the FPS have reduced criticism. However, reindeer herders still criticize the logging of old forests and excessive felling volumes.⁴⁶ The protection of predators is also one of the factors weighing on the future prospects of reindeer husbandry.⁴⁷

This general narrative of a struggling livelihood is added to and aggravated by the observed changes brought on by climate change. The movement of reindeer has changed, which has caused adaptation needs for reindeer herders.⁴⁸ Late formation of snow cover has changed the organization and timing of the round-ups. The rut has been reported as occurring later and being weaker in intensity.⁴⁹ New animal species, such as moose (*Alces alces*), compete for nutrients in reindeer ecosystems.⁵⁰ The biomass and composition of reindeer food crops have changed. The acceleration of forest growth and the spread of vascular plants have reduced the abundance of lichen in the forest ecosystem.⁵¹ Reindeer can potentially exacerbate this trend. Natural science research is still pessimistic about whether the lichen cover grows back in the worn pastures without diminishing the reindeer population.⁵² Pastures and lichen become mouldy under snow more often in prolonged autumns and mild winters. Moreover, if there are no trees and arboreal lichen available, the physique and condition of the reindeer deteriorate, and deaths due to starvation increase. In addition, diseases are increasing, and new parasitic species are spreading. Insect nuisance is expected to intensify, or to disappear (causing the reindeer to be less inclined to herd in groups, which makes gathering the reindeer for round-up more difficult). Lastly, as the size of the reindeer decreases, their condition deteriorates and their behaviour changes.⁵³ The common prognosis is that these trends will continue.

To begin with, researchers did identify some positive consequences of warming climate in the early 2000s: warmer winters can help reindeer to keep fit; prolonged growing seasons for forage plant species, early snowmelt and the increased availability of fresh forage in spring are favourable for cows and calves.⁵⁴ Lately, these have disappeared in the face of the negatives. Pasture and herding researchers stress that varying pasture types are beneficial for reindeer because they entail numerous resource areas. However, climate change may reduce habitat heterogeneity, which

45 Turunen et al. 2020, passim.

46 Turunen et al. 2020, passim.

47 Landauer et al. 2021, passim.

48 Mysterud 2013, passim.

49 Rasmus et al. 2020, passim.

50 Jaakkola et al. 2020, passim; Horstkotte et al. 2017, passim.

51 Horstkotte et al. 2022, p. 88-89.

52 Stark et al. 2023, passim.

53 Olsén et al. 2017, p. 83; Rasmus et al. 2020, passim; Stoessel et al. 2022, passim; Landauer et al. 2021, passim.

54 Vuojala-Magga et al. 2014, p. 235; Rasmus et al. 2020, passim.



Reindeer can utilize numerous kinds of pastures. Treeless mountain tops also offer relief from plagues of mosquitoes in the summer.

Image: Wikimedia Commons, Creative Commons License CC BY 3.0.

may increase competition for diminished pasture resources and lead to increased pasture pressure.⁵⁵ Moreover, researchers predict more frequent crisis winters, due to “locked” pastures caused by thick snow cover and freeze-thaw cycles.⁵⁶ In conditions of locked pastures, pastures belonging to different vegetation areas, including birch and pine forest pastures, play a major role as reserve pastures.⁵⁷ In addition, socio-cultural risks include increased difficulties in the recruitment of younger generations, due to the increasing problem of “lack of space” in the pastures. This includes related risks of disruption in the transmission of traditional knowledge and pressure to change pasture rotation and reindeer husbandry towards more industrial forms. The latter has an impact on the social reputation and status of reindeer husbandry.⁵⁸ In total, increased risks and variations in pastures/habitats and the grazing year have made forecasting more difficult, and researchers fear that the adaptability of reindeer husbandry has weakened.⁵⁹ The main prognosis of the trends is that the negative impacts will continue and will most likely worsen.

55 Horstkotte et al. 2017, *passim*.

56 Johnsen et al. 2023, p. 39, 53ff.

57 Horstkotte et al. 2017, *passim*.

58 Moen et al. 2022, p. 272-274; Olsén et al. 2017, p. 60.

59 Horstkotte et al. 2022, p. 88-90.

Sciences which study trends in (selected parts of) the ecosystem tend to find complex interactions and crossing trends. One example is the behaviour of the tree line. The two-degree increase in the average global temperature means that the forest biotope is constantly advancing, which threatens the unique flora and fauna of the treeless mountain tops with an altitude of less than 1,000 metres. Different species have very different reproduction, migration and adaptive capacities, resulting in a wide range of disturbances and imbalances.⁶⁰ Reindeer were long believed to prevent tundra greening, or tundra shrubification, which threatens to reduce the albedo effect of snow and accelerate global warming.⁶¹ The impact of grazing on the tree line has proven to be more complex in recent research than previously assumed; the inhibitory effect of reindeer grazing has applied only to deciduous trees, especially willow. Trampling and thinning of lichen cover, in turn, affects the germination of all trees along the tree line. In terms of lichen cover, the effect of reindeer has varied from negative to positive depending on the place of growth.⁶² Reindeer herders have long observed changes in forest species and forest boundaries. The growth of forests is seen as having only a minor impact on food supply: reindeer eat only the leaves of some trees, and even those only for a short time of the year. On the Finnish side, where reindeer move within a smaller area, it has been observed that shrubification is prevented and the elevation of the tree line has stagnated, but elsewhere, in the conditions of reindeer husbandry utilizing larger areas, the forest line has elevated. In areas which have not been grazed for a long time, the spread and stabilization of trees and vascular plants has been observed. Shrubification has been reinforced by the reindeer's tendency to avoid wood-growing pastures, which were no longer suitable for pastures due to changes in snow conditions. Shrubification is considered to alter reindeer's grazing preferences and use of pastures, as well as hindering pasture rotation. In relation to prognoses, the debate on the forest boundary biotope is about uncertainties, which have increased in conditions of climate change, and which in turn is making prognoses, both within science and in the field, more difficult and uncertainties more tangible; the tree line behaves differently in different parts of the reindeer herding area, and the only certainty relates to the increase in extreme phenomena.⁶³ The potentially positive impact of the reindeer vanishes in these crossing dynamics.⁶⁴

The reindeer have been a dividing factor in the research fields studying northern ecology: this is especially the case in forestry science, as the reindeer dwell in the same resource zones. Phases in forestry science, during which forestry could have been viewed as a culprit, and reindeer the victim or a provider of ecosystems services,

60 Stark et al. 2023, *passim*.

61 Landauer et al. 2021, *passim*; *Albedo effect – Norsk Polarinstitutt* (npolar.no), read 05.03.2024.

62 Stark et al. 2023, *passim*; Stoessel et al. 2022, *passim*.

63 Horstkotte et al. 2017, *passim*.

64 Climate change in Sápmi 2023, p. 93.

are exceptional.⁶⁵ Pasture research has abandoned the premise that the only factor affecting lichen pastures is the number of reindeer alone.⁶⁶ In this, research conducted by Senior Scientist Jouko Kumpula (Natural Resources Institute Finland) has been decisive.⁶⁷ Despite this, the inclusion of other forms of land use in the calculations and analysis has not been able to exempt reindeer husbandry from all charges of wear and tear on pastures. Researchers still raise concerns about the deterioration of pasture soil quality and the functionality of the grazing system, which are included in the prognoses. Worn lichen ground is not as competitive against other plant species as an intact one, and stable and increased numbers of reindeer further erode pastures impoverished by other forms of land use.⁶⁸ Demands to reduce the volume of reindeer husbandry have been commonplace in forest research.⁶⁹ In a more positive vein, reductions in all land-use forms are required.⁷⁰ To sum up, in relation to reindeer there are prognostic narratives, which point to the reindeer accelerating their own demise and ones of cooperative de-growth securing the foundations of the trade and Sámi culture.

Presented solutions for the forestry and pasture crisis

I now turn to the solutions researchers have come up with to tackle consequences of climate change. As already pointed out, there was an itinerary positivity in research about climate change. Researchers in the global west reported how it had mobilized, created cooperation with scientists and even empowered Indigenous Peoples in global forums.⁷¹ Herders have already introduced adaptive measures, such as re-scheduling the marking of calves, changing pasture rotation, and the collection of reindeer by all-terrain vehicles and helicopters, rather than snowmobiles.⁷² Reindeer management organizations envisioned adaptation measures already over ten years ago: maintaining the uniformity and diversity of the pasture areas (i.e. avoiding their fragmentation), improving reindeer health, limiting the expansion of invasive alien species, protection of the environment, considering reindeer management in legislation regulating land-use planning, developing financial instruments, and relevant research. Earlier, researchers suggested the consolidation of different land use needs and participatory planning approaches, as well as the inclusion of sustainable devel-

65 Laine 2017, *passim*; Nyysönen 2023, *passim*.

66 Compare Eftestøl et al. 2021, *passim*.

67 Nowadays, mainstream research attributes the blame to all land use forms. See e.g. Kumpula et al. 2014, *passim*.

68 Stoessel et al. 2022, *passim*; Akujärvi et al. 2014, *passim*; Helle 2011, p. 86–88; Nieminen 2008, *passim*.

69 Norokorpi 2009, p. 35.

70 Kumpula et al. 2014, p. 550–551.

71 Forbes and Stammeler 2009, *passim*.

72 Rasmus et al. 2020, *passim*.

opment and cultural aspects to planning processes, and research and education on climate risks.⁷³ New policies advocating renewable energy and infrastructural projects have outdated some of these rather generic suggestions. Co-planning measures exist, although they are criticized for low inclusion.⁷⁴ Research is ample, since the crisis has only worsened, as the biological and ecological changes (too) have turned out to be difficult to administer.

In forestry science, researchers share the idea of increasing wood stock in Lapland's forests.⁷⁵ What forestry scientists disagree on, are the forms and intensity of the solutions, and the ways in which wood reserves should be used. In one branch of forest research, personified in the work of Emeritus Professor Martti Varmola (Finnish Forest Research Institute), the old growing model based on efficient forestry, aiming for the fast growth of timber, is very much alive.⁷⁶ This conservative-industrial branch supports the increase of felling volumes because otherwise the volumes would get "out of hand" and the profits would not be reaped.⁷⁷ Another proposed solution is an ecosystem model inspired by sustainable development and biodiversity thinking, presented by Yrjö Norokorpi (University of Helsinki). In this model, in line with international conventions which preserve biodiversity, forest management planning aims to examine forest areas as a whole, identifying key biotopes which are important for safeguarding forest biodiversity. This is part of the FPS's area-ecological planning. Forest use must be economically, ecologically and socio-culturally sustainable in order to be legitimate future forest management. From the point of view of forest time, the aim is no longer a forest of the same age-class, but to allow the forests to grow at different stages of succession, which will make them less vulnerable to disruptive risks. In addition to economic returns, the legitimacy of the mode of production must be taken into account. This means taking other actors and the operating environment into account, as well as ensuring the continuation of forest management by calming the operating environment.⁷⁸ The solutions are up-to-date, technology-oriented and strongly future-oriented.

At the same time, scholars studying pasture and herding issues have presented three solutions for reindeer husbandry: the branch of research with the clearest and most open ties to the Sámi cause favours employing traditional Sámi knowledge in the organization of future reindeer husbandry and the use of pastures. These studies highlight the priorities, practices, interests, decision-making power and territorial rights of reindeer herders as a solution to the problems of reindeer husbandry and

73 Rasmus et al. 2020, 13.

74 Raitio 2008, *passim*.

75 Norokorpi 2009, *passim*; Varmola 2009, p. 9.

76 Varmola 2009, p. 13.

77 Varmola 2001, *passim*, cit. p. 22.

78 Norokorpi 2009, *passim*.

the endangerment of Sámi culture.⁷⁹ This more positive solution and its prognosis create a slightly more positive aura in Sámi discourse in these times of conflict and crisis. The solution involves adapting to irreversible climate change by practising flexible pasture rotation, where the condition of pastures is continuously assessed and the location of reindeer is adjusted accordingly.⁸⁰ A second solution is to protect pastureland, for example by banning other forms of land use, to guarantee a safe environment for reindeer herders. It is easy to see the connection between solution and the discourse on self-determination and colonialism/decolonization articulated by the Sámi movement: here, the Nordic countries' management methods and legislation on reindeer husbandry are perceived as foreign, ill-advised, incompetent and culturally destructive, due to the elimination of the old Sámi herding practices.⁸¹ As an intermediate position, it may be noted that herders' willingness to communicate traditional knowledge of herding to, and cooperate with, the officials has been reported – many times in order to delimit other activities in areas vital for herding.⁸²

In addition to traditionalist solutions, several scholars present a third solution of supplementary feeding, based on “new technologies”. This normalizing talk of supplementary feeding as a future solution, and as a rational and historical, an on-going, already permanent practice, is counter-narrative to the former idea of feeding as an indication of the crisis credited to over-grazing.⁸³ Reindeer are either fed in pens or in the pastures, for example due to the poor condition of pastures, difficult snow conditions, to prevent dispersion of the stocks, or the great threat of predators. Winter pastures are still used by numerous reindeer herders and for large stocks supplementary feeding is not feasible – supplementary feeding is still considered as an additional cost.⁸⁴ Research has found that feeding preserves reindeer husbandry and has beneficial effects on the condition of recovering pastures,⁸⁵ while the consequences to reindeer (e.g. the easier spread of disease from the fodder, and from contact with other reindeer and people) and its behavior (changed movement in the pastures, and closer contact to herder) are still being debated.⁸⁶

Each solution positions reindeer as something whose presence is protected and sustained as a living part of the ecosystem, in ways which support the herding communities as well. This is no longer a given, since biodiversity thinking and parts of forestry science tend to view reindeer as foreign, imported species, or “too many” to

79 Johnsen et al. 2023, p. 60 et passim; Mathiesen 2023, p. 1-2; Tonkopeeva et al. 2023, p. 22-24; Blind 2022, p. 278, 285; Benjaminsen (ed.) 2016, passim; Sara 2011, passim.

80 See e.g. Sara 2011, passim; Vuojala-Magga 2014, p. 238.

81 Saamelaisten asioita koskeva sovintoprosessi, Kuulemisraportti 2018; Magga 2024, passim.

82 Olsén et al. 2017, p. 60-61.

83 See e.g. Kempainen and Nieminen 2001, passim; Kumpula et al. 2014, p. 542; Turunen and Vuojala-Magga 2014, passim.

84 Turunen and Vuojala-Magga 2014, p. 175 et passim; Tonkopeeva et al. 2023, p. 23-24; Landauer et al. 2021, passim; Rasmus et al. 2020, passim; Turunen et al. 2020, passim.

85 For example, Pekkarinen 2018, passim.

86 Climate change in the Sápmi 2023, p. 97-98.

qualify as a sustainable element in a healthy ecosystem.⁸⁷ This adds to the doomsday character of the prognostic narrative of diminishing pastures, entertained from different angles and ethno-political stances in all the research cohorts studied. The industrial-conservative narrative of efficient forestry is an exception, where the resource base needs to be viable to make the growth-oriented narrative work. In the contrary positionings, the reindeer is the carrier of Sámi culture, as well as the guarantee of the wellbeing of the individual herder. In this prognostic narrative of cultural survivance, and efflorescence of pastures, it is also a stakeholder enjoying an improved pasture situation, but only if the suggested management is followed.

Concerning the present and future everyday practices of the means of living, herding appears to be adhering more to technical solutions than the traditionalist ones facing climate change. Scholars agree that the rhythms and annual cycles of reindeer herding have and will undergo changes, if and when the artificial feeding continues or increases in volume. The spatial organization will also change as the reindeer, in closer affinity with the owner, relies less on the natural pastures. Herders have a long history of sourcing technologies, resources and tools for maintaining the size and condition of the stock, and for locating them (using GPS collars and drones⁸⁸), as well as for moving faster between pastures and home, and living more comfortably. Ongoing adaptations, new research policies and continuous reindeer husbandry are counter-narratives and practices in opposition to the most pessimistic narratives of disappearance.

Conclusions

The above reading of the scientific literature on climate change has shown, how the research perceives the changes climate change causes to the (sub-) arctic environment as inevitable. The forest is a future resource both for herders and foresters, but ongoing and future changes in climate, forest, (access to) forest capital, pasture resources, ecosystems, nutrient cycles, snow conditions and food supply create uncertainties for both these livelihoods. During both the forest year, and especially the pasture year, periods have emerged which have changed their significance and potential, are uncontrollable and involve thus an increased workload or are threatening to livelihoods.⁸⁹ The primary solution to the problems for both parties, and the main performative aim of the narratives produced as well, is to lower the intensity of the competing industry; at the same time, there is less desire to scale down the activities of one's own interest group.

87 For an overview, see Nyyssönen 2023, p. 699.

88 Itkonen 2019, p. 721.

89 Vuojala-Magga et al 2011, *passim*.

My analysis of prognoses and expectations has shown that the common threat has not brought the parties together on the same side: The future of forest uses by different interest groups are still articulated as separate and partly opposed to one another. This reflects some of the characteristics of “wicked problems”: Interest groups are far apart in terms of values, tactics, problem definitions and, as we saw in this article, knowledge base and research interests, which hinder or even prevent solutions from being found. Although the problem is global and shared by all, prognoses are diverse, (always) uncertain, and depend on the interests and context, i.e. place and time where they are made. Political debate on the subject has been polarized, which has leaked into the sphere of research. Knowing this complexity may help to find partial solutions.⁹⁰

Prognoses seem to be marked on both sides by fears and frustration, more than by positive expectations.⁹¹ While the most conservative forestry research shows signs of faith in technology, and optimism about how climate change can serve its cause, the Sámi side is working on a turn towards livable futures under what is described as a crushing threat of cultural disappearance, which is exacerbated by climate change. The narrative of fragmenting pastures is dominant, to the extent that the survivance narrative seems almost an anomaly.

All parties are frustrated; forests growing in the present are not managed in familiar, profitable ways. For reindeer husbandry, climate change means that the biomass of winter food crops will decrease, and its availability will become more difficult. The change in snow conditions, reindeer deaths, less room for a choice of reserve pastures and consequences to the mental and physical health of the herders during crisis winters of locked pastures is perhaps the most dramatic consequence of climate change.⁹² In Inari, reindeer husbandry and Sámi rights issues have closed numerous stands from felling, but (industrial-scale) forestry is still, in each new stand, a short- and a long-term disadvantage to reindeer herding. Thus, it is likely that disputes will continue in the future.

The politics of temporal orientations in the solutions presented show a great split, too. The reindeer stand in different temporalities as symbol of primordial, nomadic pasts and as a factor keeping herder communities alive in the present; insofar that much of the future welfare of the Sámi is invested in the reindeer. Because of the seeming “traditionality” of the herding, the future-oriented artificial feeding relying on new technical-industrial solutions (with ties to the fodder industry, for example) is easily labelled as an unwished-for anomaly. From another point of view, the reindeer might spoil the future, by mismanagement and practices deemed as unsustainable. The traditionalist solution is based on “old”, yet still partially existing, knowledge-based practices in the pastures, but it has a clear future dimension. It is also a

90 Head 2022, p. 13-14, 95-98.

91 Koselleck [1979] 2004, p. 261.

92 Climate Change in Sápmi 2023, p. 93-103.

political project, which is being advocated at present, of salvaging future pasturing rights and the existence of the stakeholder reindeer.⁹³ Both solutions for forestry are future-oriented, and they rely on forward-looking, performance-seeking technical solutions with still visible traces in the forests/pastures, because of which their ecological sustainability is easily questioned. The threat to reindeer is still evident, and eagerly used in ethno-politics. Foresters have had to adapt to a completely new work-year, to insecurity, and to futures elsewhere than in the forests of Upper Lapland.

Neither of the industries are livelihoods of the past. However, it is striking how the past is absent in forest research. Here, the industry is a modern, future industry. This does not seem to correspond to the reality of shrinking operating space in Inari and makes it difficult to secure a position in a debate in which the competing counter-narrative presents forestry as a relic of the industrial age and a threat to the green transition, to nature-based livelihoods and the ecosystem. Within forestry its own history is not seen as a resource: it has been more successfully reinterpreted and mobilized as a threat by its opponents. In total, it remains to be seen whether the deeply siloed research will be able to adopt a more holistic approach where paths to cooperation might be found. So far, only partial solutions have been sought to the problems caused by continuous and accelerating change.

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93 Compare Clifford 2013, p. 7-8.

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Summary

Varmende "vitensskaper" i Enare, Finland – skogens, beitelandets og reinens konkurrerende framtid under klimaforandring

Hva slags fremtid er varslet for skogbruk/beitebruk i Enare, Nord-Finland i vitenskapelige studier om beitelandsøkologi, skogbruk og klimaendringer? Disse utsagn er analysert som performative prognostiske fortellinger, ment å påvirke fremtidig bruk av skog/beite. Foreslåtte løsninger for å håndtere konsekvensene av klimaendringene kartlegges også. Skogbruksstudier forteller at det haster med å høste økt vekst i sko-

gene, som opprinnelig bare ble tilskrevet klimaendringene. Risikoene har imidlertid økt i antall og hyppighet. Løsningene er fremtids- og profittorienterte, og kritiske til reindriftens begrensende effekt på skogbruket, men varierende i foreslått intensitet i skogbruket. Studier av reindriften viser en akkumulert krise av eksistensielle proporsjoner, der klimaendringene bidrar til den pågående krisen, og den samiske kulturens framtid står på spill. Løsningene som presenteres, er begrensninger i konkurrerende bruksmåter og ulike tilpasningstiltak – enten tradisjonelle/restriktive eller ved å ty til ekstra fôring. Reinen er én polariserende faktor: I de prognostiske fortellingene trues dens framtid av fragmentering av beitene, eller den utgjør en trussel mot beite-økosystemet. Fortellinger som inkluderer reinsdyr i økosystemer finnes, men fremtidig utvikling for skogene, beitemarkene og folkegruppene som bruker dem, sees fortsatt separat. Det kan bety en fortsettelse av skogbrukskonfliktene i Enare i neste tiår.