



Preservation of the cultural legacy of the indigenous Sami in northern forest reserves – Present shortcomings and future possibilities

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ABSTRACT

In Swedish Lappland, large national parks and nature reserves include forests with exceptional biodiversity values. While they are located in the ancient cultural landscapes of the indigenous Sami, this aspect has rarely been considered in the process of nature protection. In this study, we discuss how the preservation of Sami cultural values can be introduced and developed in forest reserves. We do this by reviewing recent research on the cultural legacy that the Sami have left in the boreal forest and discuss why so much of this legacy is found in the large areas of ecologically valuable forest that still exist in Lappland. We find that the Sami left deep imprints in the trees, in the forest structure, and in the archaeological record. We also find that the large forest reserves were created in the areas where the timber frontier arrived last, so they were less affected by both early actions of recurrent logging and by modern forestry. These forest reserves contain the ancient trees, the dead wood, and the disturbance regimes that favor biodiversity, and also a substantial Sami cultural legacy that has largely disappeared in the managed forest landscape. The preservation of this legacy is not without its challenges. We address the lack of inventory data, the poor collaboration between different authorities, and the general lack of involvement of the Sami communities; furthermore, we propose measures to overcome these shortcomings. If such measures are introduced, the value of the large and unique forest reserves of Swedish Lappland would be greatly enriched. The cultural legacies in forest dominated landscapes in northern Scandinavia is comparable to many other very northern or very southern regions in that they share a similar history of millennia of indigenous land use, with abrupt changes in modern time and also have large protected areas today.

1. Introduction

Forests and forest landscapes are almost always a product of the interaction between people and nature. In regions with a long history of agriculture, forests have a well-recognized imprint of human land use, and commonly, closed forest, open forest, pasture and fields have interchanged on the same land over centuries or millennia. In other regions, forests were cleared very early in time so that only small patches of remnant forest persist in the cultivated landscape. These two examples, and a range of intermediate types, are very common across temperate Europe, where the cultural history of the forest is most often intimately tied to agricultural traditions (Schama, 1995; Perlin, 2005; Agnoletti, 2006) and constitutes, for most people, the archetype of ancient cultural landscapes.

The boreal region of Europe presents a different picture. Here, forests have been a dominant landscape feature continuously since the last

deglaciation. The climate, disturbance regime, and forest structure and composition may change on a centennial or longer time scale, but the forests are constant and have not interchanged with other types of land cover. This continuous presence of forest is likely the main cause of the common misconception that we can find the last true wilderness – “Urwald”, pristine forests – in the most remote and northernmost forests in Europe. While it is true that un-logged, old-growth forests in northernmost Norway, Sweden, Finland and Russia have very high conservation and biodiversity values connected to ancient trees, dead trees and intact disturbance regimes (Berglund and Kuuluvainen, 2021), they also exhibit a significant cultural component since they have been the homeland for the indigenous Sami people for thousands of years. Therefore, these forests are classified as *domesticated landscapes* (cf. Terrell et al., 2003; Clement and Cassino, 2020), albeit very different from agrarian landscapes in temperate and hemi-boreal regions, but still contain a unique biocultural heritage from centuries of low intense land

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use (cf. Agnoletti & Santoro 2015, Agnoletti & Emanuelli 2016, Lindholm & Ekblom 2019).

The cultural influence of the Sami people on the forest landscape is usually not readily evident because they have rarely cleared land for agriculture or pasture, but instead relied on fishing, hunting, plant gathering (Rautio, 2014; Norstedt and Östlund, 2016) and, during the last c. one thousand years, reindeer husbandry (Bergman et al., 2013). The cultural influence on the landscape resulting from these activities differ in many respects from the ones related to agrarian societies, but are very similar to those performed by indigenous people in other forested far northern or far southern regions on earth (see for example Turner et al., 2000; Prince, 2001; Heffner and Heffner, 2012; Morrison and Shepard, 2013; Östlund et al., 2020b). The human relationship to the forest, the human impact over time on the forested ecosystem and the types of ancient remains are not the same as in areas where agriculture has persisted for a very long time, and therefore warrant other strategies for the preservation of the cultural heritage.

1.1. Aims

The motivation for this study is to find ways to preserve the unique cultural legacies of the Sami people in northern Swedish forests and to elucidate the connection between historical logging, ancient cultural values and today's forest reserves in northern forests. We do this by reviewing recent research in this field, and focus primarily on the Swedish parts of the homelands of the indigenous Sami in northern Sweden, but also discuss this area in a broader geographical context. The specific questions we want to discuss are the following:

- 1) What is the legacy of historic Sami land use in the boreal forest?
- 2) Why do we have large forest reserves in northern Sweden?
- 3) What are the unique cultural characteristics of the forest reserves in Lapland?
- 4) What are the challenges in the management of cultural values in natural forests, and how can they be overcome?

Furthermore, we briefly discuss the north Scandinavian example in an international context and how the preservation of the cultural heritage in forest dominated regions can be promoted in the future.

2. Material & method

2.1. Study area

The geographical focus of this review is the forested landscape of the Swedish Sami districts, the so called “*lappmarker*”, collectively known as “*Lapland*”. The area is a historical entity, known since the 14th century, which at the time delimited the area that was exclusively inhabited by the indigenous Sami (Wallerström, 1995). The area was called Lapland because the old Swedish word for the Sami is “*Lapp*”, a term that is now considered derogatory. Today the term for the Sami homelands is *Sápmi*, which also includes a broader geographical area. In the late 17th century, various incentive actions by the Crown led to an influx of Swedish- and Finnish-speaking settlers into Lapland, yet the Sami remained the dominant population well into the mid-18th century (Arell, 1979). Although the Sami are today a minority in both Lapland and Sweden, a significant number of reindeer-herding Sami still follow traditional migratory routes between winter grazing lands in the lowland forest (where reindeer feed on ground lichens) and summer grazing areas in the Scandinavian alpine mountains (where reindeer feed on herbs and grasses).

Although Lapland is no longer dominated by Sami, it still exists as a geographical province. It includes the western, inland parts of northernmost Sweden, approximately corresponding to the current municipalities of Kiruna, Gällivare, Jokkmokk, Arjeplog, and Arvidsjaur in Norrbotten County, and Malå, Sorsele, Storuman, Vilhelmina, Dorotea,

and Åsele in Västerbotten County. The area covers approximately 110,000 square kilometers. The land generally rises towards the west culminating in the Scandinavian mountains, forming the border to Norway, and which are largely covered by tree-less alpine heath and subalpine birch forest. In this study, we focus on the lower, boreal region, which is dominated by forests, wetlands, lakes, and streams. The forests mostly consist of two native coniferous species; Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* Karst.) with a minor deciduous component consisting of birches (*Betula* spp.), aspen (*Populus tremula* L.), rowan (*Sorbus aeciparia* L.) and goat willow (*Salix caprea* L.).

In order to put our focus area into a broader context, we will discuss the logging history of northern Sweden as a whole, including the northernmost counties of Sweden, Gävleborg, Västernorrland, Jämtland, Västerbotten and Norrbotten, in their entirety.

2.2. Method

This paper is primarily a review of papers on forest history and Sami cultural legacy in Swedish Lapland. Included papers were selected following two steps. First, we searched the Swedish national search service Libris (National Library of Sweden, 2021), which provides information on titles held by Swedish university and research libraries, for doctoral theses that had been published on this topic since 2010 (included). We free-text searched for theses including the words: “Sami”, “Sápmi”, “reindeer”, “forest history”, “culturally modified trees”, “archaeology”, “Lapland”, and “Lapland”, as well as the corresponding words in Swedish and with alternative spellings, and selected the theses that were within our scope (Berg, 2010; Rautio, 2014; Brännlund, 2015; Hjulman, 2017; Norstedt, 2018; Cogos, 2020; Fjellström, 2020). Since our study is aimed towards the historical legacy, we did not include theses on modern reindeer herding.

Next, we compiled a list from all the references included in the selected theses, omitting references (based on title and abstract) that were clearly not relevant for our scope. We then marked all references which potentially could be of interest for our study. This gross list with marked references can be found in the [supplementary material](#) (SM 1). Once the list was compiled, we went through the included papers to extract relevant information for the study. A number of papers were selected to be cited in our study, but we also used other papers for background information and to give context to our study. Finally, we conducted a minor complementary search to find papers on a few specific topics which were not included in the first broader search.

To put the forest history of our study area in a broader context, we have also re-examined primary historical records pertaining to the advance of the logging frontier in northern Sweden during the late 19th and early 20th centuries to construct a compiled map showing the development of the logging frontier in northern Sweden. These records are from the Swedish National Forest (Sw. Domänverket), the main landowner in the western-interior parts of northern Sweden, and from large commercial forest companies. The records are so detailed that it is possible to reconstruct the timing and advancement of the logging frontier. The records were initially extracted and used for other purposes in the following studies: Östlund (1995) described the early part of logging in the 19th century, Östlund et al. (1997); Axelsson & Östlund (2001) analyzed the central parts of our study region; and Berg et al. (2008) and Hallmén (2013) studied the northernmost parts. The data provided in these studies contained maps, logging records and very detailed forest inventories from the mid- to late 19th century. In the earliest forest inventories each management unit usually included a brief logging history of the area giving exact dates when the logging started in the area. The records were digitized or copied when these studies were done and we have not examined the records again to reconstruct the early logging in our study area. The reconstructed timber frontiers were finally presented on a map, together with the historical border of Swedish Lapland (Lantmäteriet, 2021), and the areas of all existing nature reserves and national parks as of July 28, 2021

(Länsstyrelserna, 2021) (Fig. 1).

3. Results & discussion

3.1. What is the legacy of historic Sami land use in the boreal forest?

The Sami have their traditional homeland, Sápmi, in northern Fennoscandia and northern Russia, and is the only indigenous group of Fennoscandia. The Sami ethnicity evolved approximately 2000–3000 years BP (Hansen and Olsen, 2012) and from this time onwards it is possible to discern characteristics in land use and society which have

prevailed until modern times. The traditional subsistence of the Sami has been adapted to the available resources in boreal and subarctic ecosystems, to the sharply seasonal climate and low productivity of the ecosystems at high altitudes (north of 60), and to the movement patterns of animals. Based on these primary circumstances, advanced logistics and subsistence strategies were developed (Josefsson et al., 2010a; Rautio, 2014). Fishing was particularly important and lakes and streams were used for this purpose on a regular basis (Norstedt and Östlund, 2016). Reindeer husbandry has been practiced for at least the last c. 1000 years (Bergman et al., 2013) and the annual movement of animals between the high mountains in the summer and the forest during the

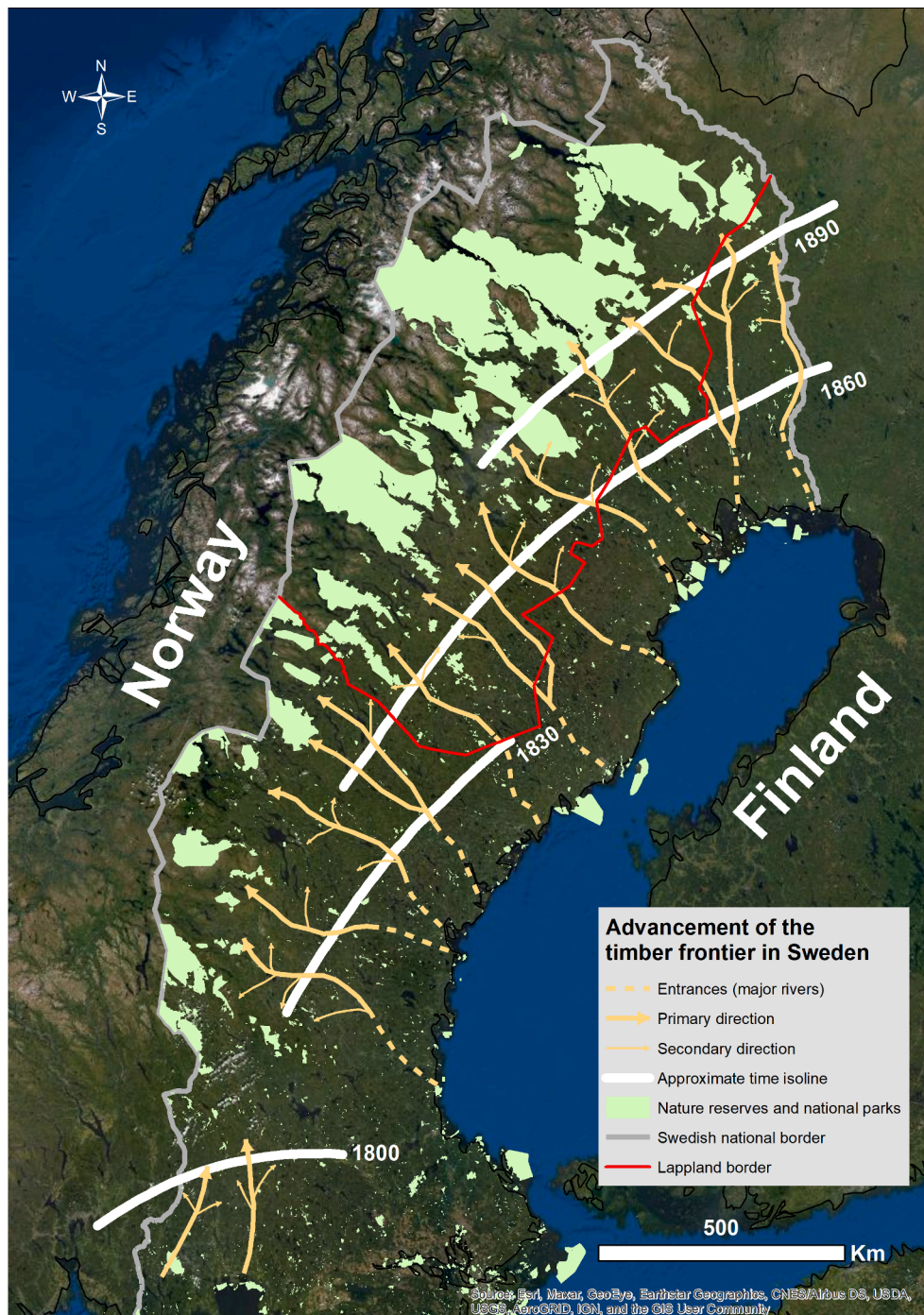


Fig. 1. Map of central-northern Sweden showing the timing and direction of the timber frontier during the 19th century in relation to the historical province of Swedish Lappland, where the Sami were the dominant population well into the 18th century. The map also shows the location and extension of national parks and nature reserves as of July 2021.

winter is still a characteristic part of most reindeer-herding Sami communities.

During the period when the Sami were in the majority in Lappland, their subsistence strategies and societal organization were the main factors of human influence on the boreal forest. Historical sources from the late 17th century show that most of the boreal forest zone was divided into Sami taxlands, territories controlled by one or sometimes several households. The size of the taxlands varied greatly between regions, but in the focus area of this paper, the average taxland was about 450 km² in 1695 (Norstedt, 2018). Since every household consisted of about five persons, population density was extremely low (Rautio et al., 2016a).

The sparse population was a result of scarce resources and of subsistence strategies that required collection of slowly reproducing resources from large areas. This type of land use required a mobile lifestyle, and therefore, traditionally-living Sami have often been called 'nomads' by ethnographers and officials (Manker, 1931; Hultblad, 1968; Cajanus, 1977 [1870]). However, the boreal forest was primarily inhabited by forest Sami, who had a number of permanent settlement sites with timber huts placed in strategic locations on the taxland. Depending on the season, they moved between specific resource areas, such as good fishing lakes and streams, plant harvest areas, hunting grounds and reindeer pastures (Rautio et al., 2014; Norstedt and Östlund, 2016). Land use changed over time, especially with the growing importance of reindeer husbandry during the 18th century (Marklund, 1999), and in the 19th century, most forest Sami spent the summers moving between simple but permanent settlements where they gathered their reindeer for daily milking in small corrals for the production of cheese (Ruong, 1944; Manker, 1968). The mountain Sami, who were more dependent on large-scale reindeer herding already in the 17th century, moved between summer pastures in the alpine mountains and winter lichen pastures in the boreal forest, usually on the taxland of a forest Sami. The Sami were thus not randomly moving around the landscape, but pursued well developed strategies for the optimal use of seasonally available resources.

This type of land use affects the landscape in different ways. One example is the intensively used environment around settlements, where fire-wood was gathered, building timber was cut down, waste was thrown out, and reindeer were gathered in limited areas. The resulting impacts are still evident in the form of a lower number of old trees and coarse woody debris in forest stands around settlements (Östlund et al., 2003; Östlund et al., 2013), vegetation changes due to trampling and manuring (Aronsson, 1991; Karlsson, 2006; Kamerling et al., 2017), and a higher presence of deciduous forest at these sites (Fig. 2). The human impact has been described as very small "cultural islands" in a largely undisturbed "sea" of forest (Berg, 2010). Due to the overall low population density of the Sami people and due to their movements to different sites with different resources on a yearly or multi-yearly basis, the intensity of land use and consequently the human impact was generally low and well below the limits for the productivity of the ecosystems, which is in stark contrast to the commercial logging at the end of the 19th century (Östlund et al., 2013; Rautio et al., 2016a). There are exceptions to this; however, they are rare and primarily limited to low-productive ecotones such as the border between alpine forest and mountains heath (Karlsson et al., 2009).

The low impact over vast areas also created subtle patterns in the landscape by leaving marks in vegetation and the forest structure (Josefsson et al., 2010b; Freschet et al., 2014) and trees (Östlund et al., 2009; Rautio et al., 2014), as well as traces such as paths and constructions at discreet sacrificial sites (Fossum, 2006; Bergman et al., 2008) (Fig. 3). A conspicuous feature of old-growth forests that have traditionally been used by Sami are the culturally modified trees that can occur both in large concentrations in the vicinity of settlements and sparsely spread over the landscape. The most well-known example are the pines that demonstrate bark-peeling scars (Zackrisson et al., 2000) (Fig. 4). In contrast to the customs of Swedish and Finnish settlers, who generally felled pines to collect the bark in times of famine, the Sami used pine bark as part of their daily food and took it from living trees, careful not to kill them, which means that the scars can persist for centuries in living and dead pines (Bergman



Fig. 2. Patch of deciduous forest (*Betula pubescens*) surrounding the Sami settlement Ligas in an otherwise Scots-pine dominated forest in the Tjeggelvas nature reserve. Centuries of trampling and land use have favored the deciduous trees over conifers.



Fig. 3. Biological legacy in the forest; wooden trap for catching ermine (*Mustela erminea*) hidden under a boulder (top right), fallen storage platform and wedge in the construction (upper left and down left), food cellar in boulder field (down right) and wooden fence for reindeers constructed of down-logs (central left).

et al., 2008; Östlund et al., 2009; Rautio et al., 2014). Another example are the lichen stumps that were left after the reindeer herders had cut down standing smaller Norway spruce or Scots pine to facilitate access to arboreal lichens for their reindeer (Berg et al., 2011). These were often located near small mires or in local clusters close to the migratory routes.

All of these culturally modified trees are valuable resources for forest-history research, since they can be dated to the year with advanced dendrochronological methods (Rautio et al., 2014; Baudet et al., 2020), and are witnesses of forest use *in situ* – showing exactly where and when a specific resource was collected (Bergman et al., 2008). Through dendrochronological dating of many such objects and

analysis of their location with GIS, a very precise landscape pattern of Sami land-use both temporally and spatially can be obtained (Berg et al., 2011; Rautio et al., 2014).

Occasionally, the Sami also actively changed their landscape, for example, through the introduction of attractive fish species into lakes, or through digging out straits to create better fishing facilities (Norstedt, 2020). Important edible plant species were likely actively dispersed, for example *Rumex acetosella* (L.) (Aronsson, 2000) and *Angelica archangelica* (L.) (Rautio et al., 2016b). Perhaps the most critical resources for the Sami was the reindeer winter grazing areas with ground and arboreal lichens growing in sparse Scots pine forests during the winter. While this is a naturally growing resource and management, in a strict



Fig. 4. Biological legacy in live and dead trees; bark-peeling scars on live and standing dead trees (top), bark-peeling scar in ancient down-log (central right), stump from tree felled for lichens (down left) and symbols inscribed in a down-log (down right).

sense, has not been done, it is a resource which is promoted by regular fire perturbations (Cogos, 2020). Fire is a very powerful tool and there is scientific discussion whether the Sami might have been involved in using fire management in some form in the past (Hörnberg et al., 2018; Cogos et al., 2019; Cogos, 2020). The extent of these practices is mainly unknown, and more research is needed to clarify the effects of Sami resource management on a landscape level.

The biological legacy in forests, vegetation and trees is closely connected to the traditional archaeological material and to historical information, such as place names from more recent times. The most important archaeological findings in the areas where the Sami have either been dominant or frequent visitors are hearths – characteristic stone-lined fire-places (Hedman, 2003; Viklund, 2004; Halinen et al.,

2013). These give precise spatial information about where people have lived and by ^{14}C -analysis of charcoal from hearths the age of the use of the hearth can be determined (Liedgren et al., 2007). Furthermore, the burnt soil underneath the hearth can give information on the season it was used and the duration of use (Liedgren et al., 2016; Liedgren et al., 2017). Place names connected to land use can remain known long after the land use has ceased and reveal earlier conditions (Cogos et al., 2019). By combining the historical, ecological and archaeological information a more complete picture of the land use can be achieved (Bürgi et al., 2017; Lindholm and Ekblom, 2019).

3.2. Why do we have large forest reserves in Swedish Lapland?

The first substantial exploitation of the inland forests in northern Scandinavia started around the mid-19th century. Rapidly increasing demand for wood in the growing economies of Europe combined with previous depletion of forests in these same countries, and liberal economic policies, resulted in timber frontiers – advancing frontiers of timber extraction from previously un-logged forests – in northern Fennoscandia, northern Russia and North America (Björklund, 1984; Flader, 1983; Nordberg et al., 2013; Östlund, 1993, 1995; Williams, 1992; Sejersted, 1980).

In northern Sweden, the forest types targeted by the commercial forest companies in the 19th century were dominated by Scots pine. Fire disturbance, both natural and anthropogenic, and wind events had shaped the forest structure both at the landscape scale and on the stand level (Zackrisson, 1977; Niklasson and Granström, 2000; Hörnberg et al., 2018). Although fire was important as a rejuvenating factor in the forest, it usually occurred as ground fires, which killed some trees but very seldom led to stand-replacing crown fires. The recurring fires shaped the forest into multi-layered forests with cohorts of trees regenerated after fires at intervals of 30–100 years. Scots pine dominated dry and mesic forests, which burnt more often; whereas wet forests, which burnt less frequently were more dominated by Norway spruce. Due to the natural longevity of the dominating tree species and the relatively low intensity of the forest fires, many forests had high numbers of very old and large trees (Linder and Östlund, 1998; Josefsson et al., 2010a). Another conspicuous feature of the un-logged old-growth forest was the large amount of dead standing trees, down-logs and coarse woody debris (Linder and Östlund, 1998). At the time, the forest was described as more grey than green due to the large numbers of standing dead trees.

The logging of Scandinavian forests was driven by commercial sawmill companies financed by national and international capitalists who saw possibilities to make huge profits by exploiting forests and selling sawn wood on the European market. Logging started in the southern part of Norway in the early part of the 19th century (Sejersted, 1980), and continued northward and further inland. The timber frontier gained some momentum when it entered the central-western part of Sweden (primarily the province of Värmland), and then became a very strong force through the exploitation of the northern boreal forest of Sweden and Finland from the mid-19th century onwards (Björklund, 1984; Nordberg et al., 2013). On the coastland of northern Sweden, the population density was relatively high, and the forest had been affected by various activities for centuries or millennia, including slash-and-burn cultivation and frequent use of fire to generate younger forests more suitable for grazing (Zackrisson, 1976). About 100 km from the coast, the population density was significantly lower, and existing farmsteads were both sparse and relatively recent. In this area, commercial logging started and then continued further inland and westward, where it gained momentum due to higher densities of older trees.

The first wave of the timber frontier was directed towards the most valuable saw timber, i.e. the very oldest and largest Scots pines. These trees could reach a diameter of up to one meter and be older than 600 years (Östlund, 1995). Therefore, at least initially, timber exploitation was conducted through “cherry picking” or high-grading across vast areas rather than harvesting all larger trees in limited areas and then moving on to a new area. As the oldest tree cohort disappeared, this first wave of logging decreased the average age of the forest. Exploitation soon created a need to target smaller trees, a development which was further accentuated with the establishment of pulp mills from the late 19th century onward. The waves of logging resulted in successively sparser forests with an increasing dominance of Norway spruce (Ericsson et al., 2000).

The timber frontier had three main directions; from the south to the north; from the coast and then inland towards Lapland; and finally, from the vicinity of the main rivers towards the watershed divides. The

re-examination of the forest inventories from commercial and state forests provides precise details on the timing and extent of the initial logging. In the southern part of Lapland (the southernmost part of Västerbotten County) logging started around 1830 (Östlund et al., 1997; Axelsson and Östlund, 2001), advanced towards the southern part of Norrbotten County around 1860 (Berg et al., 2008) and reached the northernmost part of Lapland about 1890 (Hallmén, 2013) (Fig. 1). The advancement of the timber frontier slowed down when it reached the lower mountains due to its increased distance to the coast, the increased cost of transportation, and because at higher altitudes the quality of the timber was lower and the trees smaller. The consequence of these complex factors and the timing of the first logging is that less intensively logged old-growth forests or forest landscapes are currently found in the interior of Lapland, along the Scandinavian mountain range. While few unlogged areas remain (Josefsson et al., 2009), many of the present forest reserves in the northernmost region were only subjected to a very light high-grading at the end of the timber frontier movement in the early 20th century (Josefsson et al., 2010c).

The consequences of early forestry for Sami communities are poorly investigated, but one well-supported effect is that up to 50% of the winter grazing grounds have been lost, and that much of the rest has been severely damaged (Sandström et al., 2006; Berg et al., 2008). Although Sami reindeer herding persisted all over Lapland, the areas of unexploited forests beyond the timber frontiers therefore became extremely valuable for traditional Sami land use.

The late arrival of the timber frontier in Swedish Lapland coincided with the establishment of the first national parks in Sweden (Hägerstrand, 1991). Therefore, some forests which had more or less escaped logging were destined to become the first national parks and forest reserves on the basic assumption that they were representative of the pristine forest and wilderness of northern Scandinavia (Forslund, 1915; Hjulman, 2017). An important inspiration for this early nature conservation movement in Sweden was the establishment of national parks in North America which occurred at the same time (cf. Schelhas, 2001). In both cases, the main proponents were naturalists and, later ecologists. Little or no regard was taken into account of the fact that the “wilderness” was the homeland of indigenous people. The Sami were never evicted from protected areas, and their reindeer herding rights were upheld. Nevertheless, these rights were in many cases indirectly affected by the introduction of hunting restrictions, especially on predators (Hjulman, 2017) and also by increased tourism.

During the 20th century, large areas in Swedish Lapland were successively set aside as national parks and forest reserves in order to save the remaining natural forests from logging and other forms of exploitation. In most cases, the motivation was that these forests were seen as pristine with very limited or no human impact. The primary factors considered when new areas were set aside were lack of signs of early logging (large high-grading stumps), as well as signs of modern forestry such as clear-cutting, thinning of forests or forest road constructions (Naturvårdsverket and Skogsstyrelsen, 1982). Later, the focus shifted towards criteria based on biodiversity rather than on the degree of human impact (Norén, 1995; Naturvårdsverket, 2003; Norén et al., 2014). Meanwhile, the role of the Sami in the forest landscape was either mostly neglected or considered to be of no importance.

Today, in the two northernmost counties, Västerbotten and Norrbotten, containing the province of Lapland (Fig. 1), 11% and 23%, respectively of the forest land is protected (these figures include both productive and non-productive forests).

3.3. What are the unique cultural characteristics of the forest reserves in Lapland?

During the 20th century, Swedish forestry evolved into an intense and highly industrialized business with clear-cutting as the dominant harvesting method and extensive use of soil scarification to facilitate regeneration. This has had devastating effects for the cultural legacy of

the Sami. Already in the early days of exploitation, when valuable timber trees were high-graded, most culturally modified trees disappeared from the exploited forest landscape. Even today, yearly surveys show that when forestry measures are pursued in Sweden, 10–20 % of known cultural remains are damaged, primarily through soil scarification, but also through the impact of heavy machines (Riksantikvarieämbetet, 2020). It seems reasonable to believe that unknown remains are damaged to an even larger extent, and given that Lappland is generally poorly surveyed (Andersson et al., 2008; Karlsson, 2014), remains of Sami land use are likely to disappear without ever having been recorded. Therefore, although natural reserves were generally not set aside to protect Sami cultural heritage, they are more often becoming outstanding archives in this respect.

One example is Tjeggelvas nature reserve in the county of Norrbotten, which comprises 328 km². At the time this reserve was set aside in 1988, it was one of several areas along the Scandinavian mountain range that were considered to be “some of the most valuable pristine forests of the country”. It was also considered to have high values for ecology, zoology and botany, for outdoor activities, and the landscape was labeled as genuine and untouched. It is true that the Sami were also mentioned. Most importantly, the value of the old-growth forest to provide arboreal lichens for the reindeer was recognized, and it was made clear that the reserves should in no way impede reindeer husbandry. Earlier human presence was also mentioned, but only to conclude that although the Sami had felled trees to provide lichens for their reindeer and to gather firewood, they had not to a larger extent affected the forest ecosystem. The cultural values of the forest were not evaluated (Länstyrelsen Norrbotten, 1988).

As a result of many years of forest history research in Tjeggelvas nature reserve, we know that the area is full of cultural remains. Apart from two abandoned settlements (established by Sami) where small-scale agriculture was practiced, there are hundreds of hearths, each representing a semi-permanent or temporary dwelling place.

Furthermore, there are probably more than 100 000 trees with bark-peeling scars, more than 80 000 lichen stumps and many other cultural objects such as storage platforms, trees marked for trap-lines and even sacred trees (numbers based on inventory data in Josefsson et al 2010b). In a landscape that is otherwise used for industrial forestry, a nature reserve such as Tjeggelvas has immense values not only for biodiversity, but also for the cultural heritage of the Sami (Fig. 5). Most nature reserves have not been the focus of such extensive research; however, there is no reason to believe that Tjeggelvas is unique in this respect.

The remaining un-logged old-growth forests of northern Scandinavia are unique in a European perspective. They contain entire landscapes where the regeneration and dynamics of the forest have been primarily driven by natural factors such as fire and wind since the time of the last glaciation about 10 000 years ago. These forests have never been cleared for agriculture, have never been subjected to modern forestry, and entire landscapes have been forested for thousands of years. They contain unique ecological values due to the age of the trees, natural forest structure, the presence of dead wood and biodiversity and wildlife. It is easy to understand the need to preserve these qualities when forests outside the reserves and national parks are under increasing pressure from the forest industry. However, it has become increasingly clear that these same forests have unique cultural values, as the homeland for the Sami people for millennia, and have been used in ways that have left clear imprints.

3.4. What are the challenges in the management of cultural values in natural forests? How can they be overcome – In a Swedish and an international perspective?

In this review, we have focused on the forests reserves and national parks with seemingly natural forest within Swedish Lappland. We have shown that not only do they have high ecological values, but also a long



Fig. 5. Aerial photo of the central parts of the Tjeggelvas nature reserve, Sweden. Within this picture there is the important fishing lake Plähkkájávvre (center in picture) with numerous Sami hearths near the shore and numerous bark-peeled trees, the old burnt area (Guorbak) for reindeer grazing (left in the picture) and where lichen stumps can be found, transition zones when the reindeers moved to the mountains (at the far end towards the mountains), harvest areas for plants along the creeks to the lakes, traplines for catching fur animals and other parts of a domesticated landscape.

history of Sami land use, which is today visible in the form of a unique biological and archaeological heritage. We have also shown that the reason for the protection of these forests is primarily linked to their location at the end of the timber frontier, which rolled over most forests in northern Sweden during the 19th century. Furthermore, the forest reserves and national parks differ substantially in both these two respects from the intensively managed forest in other parts of northern Sweden. In the managed forest, both the ecological qualities and the cultural heritage have been largely lost due to repeated logging of old trees, loss of dead trees and soil scarification.

The strong focus on preserving “pristine” forests and their biodiversity has been beneficial leading to very large areas being protected in this region. However, it has also resulted in a lack of focus and consequently neglect when it comes to the cultural values. We argue that it would be respectful to the Sami people, facilitate better management and increase the public interest and awareness if a new integrated view on these forests was developed.

There is a growing awareness in Sweden of the importance of considering Sami interests in nature conservation. However, while current guidelines speak about finding solutions which promote “Sami culture, community life and reindeer husbandry”, when nature reserves are created (Hagsgård, 2016; Torp, 2016; Naturvårdsverket, 2019) these solutions are largely limited to current reindeer husbandry. By contrast, the Sami cultural heritage contained in the same forest reserves and national parks is very seldom brought forward as a positive factor. It is therefore critical to acknowledge this and to include Sami participation in management. From an historical perspective, this is an important task since the presentation of natural reserves as wilderness areas with no known cultural remains contains a clear element of colonialism (Reimerson, 2015; Hjulman, 2017). Even today, the colonization of northern Sweden and the subsequent diminishing legal rights of the Sami people during more than 200 years persists. The Sami people must take legal action in the courts to protect their customary right to reindeer grazing lands in the forest, the right to fish and hunt within their homeland, against the intrusion of industrial forestry, hydroelectric power dams, mining projects, and windmills, and against the interest of other hunters and fishers (Östlund et al., 2020a). From this perspective, the image of an empty and pristine wilderness, where nature is thought to have developed without human interference, is disrespectful towards the Sami and their cultural heritage, and especially since the same reserves may be the most important keepers of Sami cultural landscapes existing today.

In most cases, the neglect of nature reserves as cultural landscapes is due to a lack of knowledge. Although it must be assumed on historical grounds that most protected forest areas in Swedish Lapland have cultural values of the same magnitude as the Tjeggelvas reserve, there is rarely any documentation to support this. For example, one of the largest nature reserves established in 2020 in Norrbotten County, Vathaanvaara in Kiruna Municipality, covers 28 km² of forests, wetlands, lakes and streams. The database kept by the National Heritage Board does not contain a single cultural remain registered in the area, despite the fact that the reserve is located in an area that has been used by the Sami people since time immemorial (Ruong, 1937). There are no detailed historical accounts of land use far back in time, but the area was documented as regular winter grazing lands of the Talma Sami in the early 20th century (Svonni and Allas, 1999). If no traces of this land use have been registered, this is most likely due to a lack of directed inventories. In the absence of data, Vathaanvaara is presented by the County Administrative Board as pristine with only its outstanding biodiversity values highlighted (Länsstyrelsen Norrbotten, 2020).

Furthermore, the generally poor knowledge of the cultural values of nature reserves is largely a result of the legislation currently in place. Nature reserves are established according to provisions of the Swedish Environmental Code, which states that such reserves may be established to preserve biodiversity, manage and protect valuable natural habitats, to protect, restore or create habitats for valuable species, or to secure

areas for outdoor activities. Cultural values are not listed among the criteria for creating nature reserves. There is, however, another form of protection, the culture reserve, which is established to protect valuable landscapes shaped by cultural activities, according to another paragraph of the Environmental Code. At present, there are two cultural reserves in Sweden that concern Sami milieus, Atoklinten in Storuman Municipality and Fatmomakke church village in Vilhelmina Municipality, but neither is located in the vast forest landscape where most Sami activities have occurred. Many nature reserves could have been culture reserves as well, but current legislation is not drafted to take cultural values into account when creating reserves in landscapes with high natural values. There is an urgent need to investigate how this could be done.

One way to enhance the general knowledge of cultural values in the forest landscape would be to facilitate the registration of ancient remains. Today, only a few designated archaeologists in each county are authorized to register cultural remains in the database of the National Heritage Board, and as a rule they have to visit each site before registration. Cultural remains that are detected by ecologists performing surveys before the creation of a nature reserve, or by dedicated amateurs, will generally remain in the individual’s notebook. This situation is in sharp contrast with the registration of species data, which can be done by anyone at the designated national web site Artportalen (SLU Artdatabanken, 2021). We argue that simplified, open procedures for registration of cultural remains should be developed.

Also, it is unfortunate that the administration of nature reserves and the preservation of the cultural heritage is handled separately at both the county and national levels. An additional complication is that those employed at the different sections have very different backgrounds; individuals working with forest reserves are mostly ecologists, while those working with cultural heritage are mostly archaeologists. The separation in organization and background does not encourage collaboration. Considering both groups work within the same landscapes and each group has a separate sets of keys to decipher the intricate and intrinsic qualities of the landscapes, many benefits would result from better collaboration. In our opinion, joint projects, shared fieldwork and investigations, and joint management goals would promote much better management of these unique forests. Such collaborations work well in research, as has been proven in many projects (Briggs et al., 2006; Östlund et al., 2015).

Consequently, we see many possibilities to improve the present situation. As researchers, we have a responsibility to intensify inclusive and decolonizing research on land use in forest ecosystems where indigenous people have lived for millennia. Only a fraction of the forest reserves and national parks have been studied with the aim of understanding Sami land use in Sweden. We suggest that research on land-use intensity in ecosystems with different productivity, gradients of forest structure around settlements and the long-term influence of reindeer pastoralism be further investigated. Such research would provide a foundation for understanding the Sami cultural landscapes. Additionally, it would promote a more general understanding of how indigenous people use and shape their environment through centuries of low intensity and spatially broad domestication of their homelands.

The cultural legacies in forest dominated landscapes in northern Scandinavia are comparable to many other very northern or very southern regions on earth, but also very different to regions at lower latitudes where either the human population has been much denser or agriculture has dominated land-use for centuries or millennia. The connecting factors in the far north and far south are often complex subsistence strategies developed for and within forest ecosystems, millennia of indigenous land-use, rapid European colonization and commercial large-scale logging in the 18th and 20th century, and, more recently, establishment of very large forest reserves in the 20th and 21st centuries. These similarities are evident in areas such as northern Fennoscandia, western North America, parts of Siberia and in South America (cf. Denevan, 1992; Östlund et al., 1997; Delcourt and Delcourt, 2004; Almada et al 2016; Zegers et al., 2020). The end result of this

complex history is, as in many other similar cases, large protected forested areas with unique ecological values and a unique bio-cultural heritage of land use by indigenous peoples. Such a situation warrants knowledge and awareness among land managers and creative solutions to potential conflicts between ecologists and archaeologists. We see excellent opportunities to learn from similar research conducted in distant regions; the challenges that there are seldom established collaborations between, for example, Patagonia and northern Fennoscandia or between the southern part of New Zealand and Alaska, remain.

Thus, it is important to develop new theoretical and methodological frameworks, specifically adapted to the unique cultural landscapes in these remote but similar regions. Based on the findings from this review we suggest some general approaches. First, inclusion of indigenous people and an in-depth understanding of their historical and present land-use is needed when new forest reserves are created, when management targets are developed and in research. Turner and others have shown the great potential and importance of long term local collaboration with communities in the management of natural resources in western North America (see for example Turner, 2020). Second, new methods, such as LIDAR or broad investigations focusing on large forested landscapes must be applied (see for example Josefsson et al., 2010c; Norstedt et al., 2020; van der Sluijs et al., 2020). Third, and perhaps the most challenging, archaeologists and ecologists must increase collaboration with the understanding that they share common goals and can learn skills from one another. This final suggestion may sound simple to implement, however, archaeologists and ecologists come from very different cultures and often believe they have opposing goals with their work. On one hand, archaeologists want to understand how landscapes have been used and shaped by people in the past, on the other hand ecologists want to protect naturalness and natural ecosystems. The integrated collaboration towards a common goal with specific focus on the bio-cultural heritage have been successfully developed for other regions in Scandinavia (Lindholm and Ekblom, 2019) and could be modified to become functional tools in the northern boreal and subarctic environments. Future research should preferably be conducted in an interdisciplinary context since different disciplines are needed to decipher the complex interaction between indigenous people and their environment over long time perspectives.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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