

Sami herders' classification system of reindeer winter pastures – A contribution to adapt forest management to reindeer herding in northern Sweden

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Abstract. The system for classifying vegetation types currently used in Swedish forestry has two major deficiencies when identifying reindeer winter pastures: it uses lichen cover as the sole criterion for defining them, and it ignores the possible adverse effects of snow cover. Based on ethnological field studies, this paper examines Sami reindeer herders' classification of reindeer winter pastures, and compares it to the system used by foresters at different levels of classification. At the lower level, which deals with identifying discrete entities, it is possible to find some correspondence between the representations of forest characteristics used by the Sami herders and the foresters. Reindeer herders discriminate the same factors – tree height, canopy enclosure, stem density, field-layer, bottom-layer – as forest manager, but the former use this knowledge to evaluate the effects on snow cover and ice, and thus on the accessibility of the lichen beneath. Inconsistencies appear at the second level of classification, which consists in ordering this variety of forest characteristics into a classificatory system. There is a mismatch between Sami herders and forester's representations and classifications of pastures because Sami categories are 'complex', *i.e.* categories including many criteria that have to be combined and balanced before defining the pasture. Herders' representation of pasture is thus holistic, rather than purely botanical. The comparison of the two classification systems demonstrates that it is impossible to define grazing quality solely in terms of lichen abundance, because of the multi-dimensional nature of reindeer winter pastures and consequent shifts (spatial and temporal) in its quality.

Key words: ethnoscience; forest management; pasture classification; reindeer herding; reindeer lichen; traditional ecological knowledge; vegetation type; winter pasture.

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Introduction

In the course of my studies (Roturier, 2009) on the restoration of lichen-dominated pine forests that has been disturbed by modern forestry, questions arose regarding the forest types or the final ecosystem state that should be targeted in restoration programmes. As a result I became naturally interested in Sami reindeer herders' definition of the reindeer winter pastures.

It is well known that during winter epigeic reindeer lichen (*Cladonia* spp.) constitutes a

major proportion (50-80%) of the reindeer (*Rangifer tarandus tarandus* L.) diet (Gultsjak, 1954 in Skjenneberg & Slagsvold, 1968; Bergerud & Nolan, 1970; Heggberget *et al.*, 2002). It is therefore not surprising that forestry companies and most observers typically consider the quality of reindeer pastures to be proportional to the amount of reindeer lichen on the ground. In accordance with early works of the Swedish botanists Arnborg (1945) and Malmström (1947), and the classification of

vegetation types introduced by Hägglund & Lundmark (1982), the Swedish forest industry has classified ground vegetation using a system that grades vegetation types according to their potential timber productivity. According to this classification system, lichen types dominate on the least-productive soils, since they appear to be restricted to well-drained surfaces of soil in which the vigour of vascular plants is impaired by low fertility (Ahti & Oksanen, 1990; Crittenden, 2000). According to the identification key provided by Hägglund & Lundmark (1982), the first step is to determine whether the vegetation is of “*lichen soils*” or “*moss soils*” type, depending whether lichens constitute more than, or less than, 25% of the bottom layer, respectively (Fig. 1). This has practical implications in forestry and for reindeer herding. Both for productive reasons and consideration to reindeer herding, forest companies may avoid implementing some silvicultural measures (e.g. fertilisation, soil preparation) on the poorest sites, i.e. on *lichen soils*, thus avoiding disturbance of the ground vegetation locally. However, once a site has been classified as *moss soil*, there is no particular restriction on the use of radical silvicultural measures even though up to 25% of the ground may be covered by lichen.

This raises questions regarding the classification of reindeer pasture. Several authors have addressed these questions in attempts to establish relationships between forest types and seasonal reindeer pasture quality (Thun, 2005). Notably, Skuncke (1958, 1959) tried to grade the productivity of vegetation types with respect to their quality as reindeer forage in a similar way than foresters do for forest productivity. Eriksson (1979) proposed an adaptation of Arnborg’s (1945) forest types according to their use by reindeer herding, merging forest types considered as equivalent for reindeer grazing. More recently, in 2000, the Swedish Forest Agency created Land Use

Plans for Reindeer Husbandry (*Renbruksplan*) with the aim of classifying the importance of grazing areas, drawing on participation of reindeer herding communities and information from vegetation and satellite maps (Sandström *et al.*, 2003). However, all these classification systems are based exclusively on botanical variables and do not account for a major factor at these northern latitudes, namely the effects of snow and ice. Layers of hard snow or ice can make it impossible for reindeer to access lichen under the snow cover. The snow factor thus challenges any attempts to classify reindeer pastures quality on the basis of botanical information alone.

Because current schemes for relating ground vegetation types to reindeer pasture value do not account for the facts that the quality of pasture is not solely dependent on its lichen cover and that snow can hinder access to lichen, they are deficient in two crucial respects. These two points can be addressed by examining Sami herders’ view and classification of winter pasture. The study of indigenous and local knowledge within the framework of ethnoscience, the study of folk categories and classification systems, can be useful in achieving this objective. For this, we have to distinguish levels of classification, which consists of first identifying discrete entities through naming, and second, ordering them into a classificatory system (Friedberg, 1999). Observations of the milieu, representations and practices necessarily play a part at every stage of this process. Within the framework of ethnoscience the analysis of the different stages of the process in the case of reindeer winter pasture can be used to study Sami reindeer herders’ knowledge of their milieu, and to compare folk and scientific representations and classifications of the same natural objects. Based on three years of ethnographic fieldwork, including participant observation and interviews with Sami herders from the herding communities of Jokkmokk,

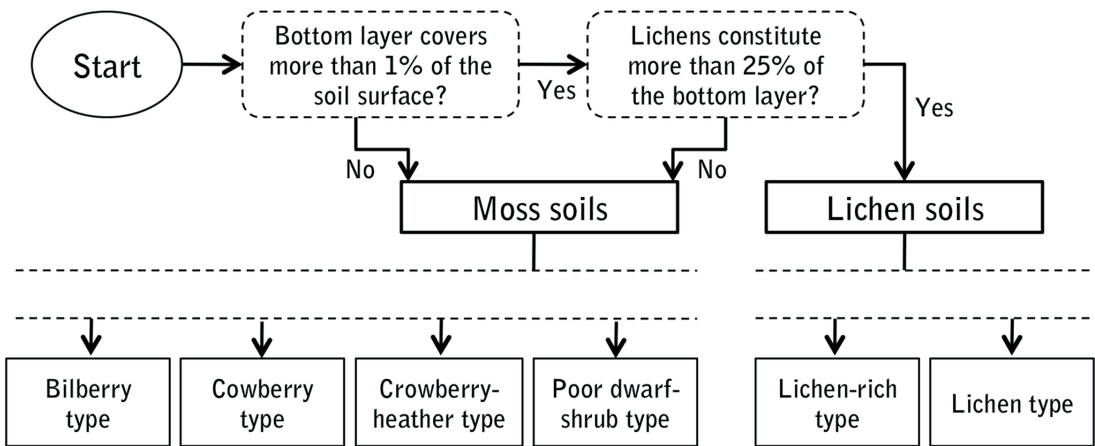


Fig. 1. Scheme for the classification of vegetation type according to Hägglund & Lundmark (1982); see www-markinfo.slu.se/eng/vegeta/vegtyp.html for the complete classification in English.

Sweden, this paper provides insights into Sami herders' categories of reindeer winter pastures, and clarifies inconsistencies between the classifications used by Sami herders and Swedish foresters.

Identification and representation of pastures in forest by Sami herders

Reindeer pastures and snow

Since it is the main grazing resource for reindeer during the winter months (Gultsjak, 1954 in Skjenneberg & Slagsvold, 1968; Bergerud & Nolan, 1970; Heggberget *et al.*, 2002) reindeer lichen is naturally recognized as an essential constituent of reindeer pasture by both Sami herders and the scientific community. However, any researcher who discusses factors related to winter pasture with reindeer herders quickly finds that the snow cover, and whether the reindeer can dig through it to reach the lichen below, are crucial considerations. As demonstrated by Roturier & Roué (2009), the word *guohtom*¹ ('pasture') lies at the heart of herders' representations of reindeer winter pastures. In Sami, *guohtom* has additional dimen-

sions to those commonly ascribed to pasture in western languages. Although it is translated as '*bete*' in Swedish ('pasture' in English) in specialized literature (Ruong, 1964; Nielsen & Nesheim, 1979 [1932-1962]; Svonni, 1990), and by herders themselves when they speak Swedish, it embodies the interactions between snow, pastures and reindeer. Herders' definition of *guohtom* is not restricted to the presence of a suitable plant community (*i.e.* epigeic lichens) for grazing; it also conveys the additional notion of whether it is possible for reindeer to access the pasture under the snow layer. For Sami reindeer herders, the snow cover is as important as the abundance of lichen. When the reindeer cannot access the lichen through the snow, the *guohtom* disappears; the land is no longer considered to be reindeer pasture anymore, even though the ground might actually be covered with reindeer lichen (Roturier & Roué, 2009).

For herders, snow is thus a crucial component of pasture. The snow cover characteristics are highly dependent on the temperature and wind conditions during its formation. After deposition, snow particles are modified by metamorphism, a process that is primarily affected by temperature variation, the accumula-

1 The spelling of Sami words is in Lule Sami as it was the dominant dialect among Sami herders interviewed in this study.

tion of further snow, and the wind (Gray & Male, 1981). These factors are in turn affected by the properties of the vegetation, including overstory and understory vegetation, through canopy enclosure and energy exchanges that have significant effects on the density (Gray & Male, 1981; Ottosson-Löfvenius *et al.*, 2003), and accumulation and ablation (Metcalf & Buttle, 1998; Weiping *et al.*, 2008) of the snow cover. Clear-cut areas always accumulate more snow, due to the absence of trees, than adjacent forest stands (Golding & Swanson, 1986; Ottosson-Löfvenius *et al.*, 2003). The academic works cited in this brief review highlight the complexity of the factors affecting snow cover formation in boreal forests. The following two sub-sections discuss the significance of this complexity for Sami herders.

Forest structure and reindeer pasture

Sami reindeer herders generally contrast *old forest* with *young forest*. According to herders, trees in old forests trap part of snowfalls, thereby significantly reducing the depth of the snow on the ground. In younger stands, with smaller trees or small seedlings, most of the snow accumulates on the ground, resulting in a deeper snow cover, as also acknowledged by academic literature (Golding & Swanson, 1986; Ottosson-Löfvenius *et al.*, 2003). When early snowfalls have occurred in late autumn and the temperature increases above 0 °C, thawing occurs. In young forests the thicker snow cover melts partially and decreases in depth, but the snow that remains freezes and turns to ice when the temperature drops below 0 °C again. In older forests, herders observe that the shallower snow cover may completely melt, leaving the ground free from melted snow and ice. Under such circumstances, reindeer therefore use older forests for grazing because the younger forests are “locked in” by ice.

Conversely, herders state that thaw-freeze cycles later in the winter season can also result

in opposite effects on reindeer’s use of the pastures. In old forests, all the snow trapped in the higher canopy falls in clumps under tree crowns. This is not the case in younger forests, where trees are smaller. When all the snow that has accumulated in the canopy of a dense even-aged stand melts and falls down, the snow cover is compacted over the whole stand. In such cases, reindeer herders say they can only use stands with lower stem density, or stands in which younger trees with smaller crowns had not trapped as much snow. This apparent contradiction is due to the difference of the timing of the thaw-freeze in the two cases; in the first case, an early thaw-freeze damage the pasture in young forests, while in the second case, a late thaw-freeze damage the pasture in older or denser forests. This simple example shows that in addition to lichen and snow, the characteristics of the tree cover and meteorological variations are also important criteria in herders’ representation of winter pasture quality.

Ground vegetation, frozen bådne and snow

According to herders, ground vegetation such as dwarf-shrubs, and the presence of rocks, influences the consistency of the snow on the ground and may under some conditions facilitate reindeer grazing. As is the case with trees, the understory vegetation affects snow accumulation and cover; moreover ground vegetation also plays a key role in the formation of ice near the ground.

To better understand this phenomenon, it is necessary here to focus on a semantic category that is widely used by Sami herders in Jokkmokk communities and that is essential for understanding their representation of winter pastures: *bådne* (the Sami word for ‘bottom’). In the context of reindeer grazing, *bådne* has a clear meaning: it refers to the lowermost snow layer in contact with the vegetation, *i.e.* the bottom of the snow layer. It was defined as follows by an old reindeer herder:

One can talk about the bådne of a lake, or a cave. But for us, when we speak about pasture, we know what bådne means: it is the bottom of the snow, its lower boundary. This is the bådne. It is not the upper boundary of the ground. Bådne is the bottom, not the top.

For reindeer herders, the most important aspect of *bådne* is that the snow or the ice should not fasten to the vegetation or “lock it in”. According to herders, this happens almost every year to some extent, and checking the *bådne* is as important as checking the lichen and the snow depth (Roturier & Roué, 2009). When the *bådne* freezes completely, the reindeer cannot dig through the snow or even smell the lichen, and thus cannot access it.

When speaking in Swedish, Sami reindeer herders generally distinguish between lands with “thin humus” and lands with “thick humus” (see also Roturier & Roué, 2009). The former refers to lichen-heath vegetation with extensive ground lichen cover on podzolised soil, while the latter refers to ericaceous dwarf shrub vegetation with feather mosses (mostly *Pleurozium schreberi* Bridd.) and some patches of ground lichen. When asked to define these terms in Sami, older herders having Sami as their mother tongue say only that “thick humus” is *såmolednam* (‘moss-land’); it is likely that the concept of humus was incorporated into herders’ vocabulary only after making contact with foresters, at least in the Jokkmokk area. The linguistic study of these two categories remains incomplete and their distinction could require further investigation. However, I was able to identify two descriptions of grazing on *såmolednam*, when the lichen-heaths were frozen, in the literature (Skuncke, 1963: 179; Ruong, 1964); interestingly Ruong’s informants referred to this land as *sarmmeednam* (Ruong, 1964: 91). Apart from describing the extent of lichen, the key aspect that herders consider when using these two categories is the

tendency for the *bådne* to freeze, *i.e.* whether water released from thawing snow flows through the vegetation before re-freezing, or pools on the ground and subsequently forms an ice layer near the ground, encapsulating the lichen. According to herders, in forests with “thick humus”, or in *såmolednam*, the water flows down through the generally thick moss layer, leaving the lichen accessible for the reindeer to graze. In contrast, in areas with “thin humus” and lichen-dominated vegetation, the water pools on the lichen mat, forming a crust of ice when freezing, reducing the lichen’s availability as reindeer fodder. As such, the state of the *bådne* and the sensitivity of different vegetation types to freezing at the *bådne* level are also essential criteria in reindeer herders’ representation of pasture quality.

Sami herders’ classification of pastures and foresters’ classification of ground vegetation

As illustrated in the preceding discussion of some simple and commonly-encountered situations, at the first level of classification, the recognition of the ecosystem discontinuity, or forest diversity including all its components, is common to both scientific and folk representations. Sami herders distinguish the same factors – tree height, canopy enclosure, stem density – as forest managers when planning their production activities and describing the structure of the forest. Likewise, both herders and forest botanists distinguish between the field-layer, the bottom-layer and impediments such as rocks. However inconsistencies between folk and scientific representations become apparent at the second level of classification. For instance, it would be tempting here to correlate the herders’ categories *thick humus* and *thin humus* respectively with the forest ground vegetation classes *moss soils* and *lichen soils* proposed by Hågglund & Lundmark (1982), since they correspond somewhat. However, in

Hägglund & Lundmark's classification system the only criterion used to differentiate between *lichen soils* and *moss soils* is the percentage of lichen cover. Sami categories, in addition to distinguishing categories of humus thickness and associated plant communities, inform us about the likely state of the *báddne*, and the likelihood for the pasture escaping freezing. Consequently, they tell us much more about the actual possibilities for reindeer to access lichen under a given snow cover, *i.e.* they reflect the full complexity and richness of the Sami word *guohtom*. The same is true of the categories that define forest structure, which are primarily used by reindeer herders to determine how the tree cover will interact with snowfalls and meteorological conditions. Thus while both Sami herders and forest managers may recognize forest discontinuity in a similar manner, the representation of pasture by herders is multi-dimensional and far more complex than the forester's representation, based solely on the extent of lichen cover. Sami reindeer herders thus identify pastures using a combination of criteria, relating to factors such as lichen cover, snow cover, forest structure,

vegetation type, meteorological variation and *báddne*. In this respect, *guohtom* is typical of what Friedberg (1999) called a 'complex category', a "categor[y] defined by criteria belonging to different domains. Floristic composition plays a part in the definition, but in combination with other characters". Considering all the vast permutations of variables that affect the snow cover, and hence the quality of reindeer winter pastures, is clearly far from straightforward, but essential for robust appraisals.

Returning to the comparison between the Swedish classification system of ground vegetation (Hägglund & Lundmark, 1982) and herders' classification system, we are now better able to elucidate inconsistencies between these indigenous and scientific systems. Table 1 shows the vegetation types identified using the system of Hägglund & Lundmark (1982) on the basis of the lichen coverage alongside some of the Sami categories used to express the quality of reindeer grazing sites, both in ascending order of importance. To simplify the comparison, the potential effects of the tree cover on snow conditions are ignored. In general, when snow conditions are normal, the graz-

Table 1. Comparison between the classification of vegetation types currently used in Swedish forestry (Hägglund & Lundmark, 1982) and the classification of winter grazing by Sami reindeer herders according to this study. "Y" and "N" indicate vegetation types where grazing is possible or impossible, respectively, for different Sami categories. Vegetation types are listed in the order of lichen abundance.

	Vegetation types					Forest with epiphytic lichen
	Lichen soils		Moss soils			
Lule Sami grazing categories	Lichen type	Lichen-rich type	Poor dwarf-shrub type	Crowberry-heather type	Cowberry type	
<i>Gudna guohtom</i>	Y	Y	Y	Y	Y	
<i>Guohtom</i>	Y	Y				
<i>Báddne-vihke</i>	N	N				
<i>Dajvak guohtom</i>			Y	Y	Y	
<i>Tjuohke</i>	N	N	N	N	N	Y

ing, *guohtom*, occurs at places where the plant community is dominated by epigeic lichen, *i.e.* *lichen* and *lichen-rich* types, while other vegetation types on *moss soils* are not grazed. Perfect snow conditions during the whole winter season that present no hindrance at all to the reindeer's grazing are referred to by the herders as *gudna guohtom* ('good *guohtom*'); under such conditions, reindeer can graze anywhere epigeic lichen is present, even where its abundance is comparatively low. As explained above, the lichen-dominated grounds are more sensitive to frozen *báddne* according to the herders. Frozen *báddne* can be referred to as *báddnevihke* in Lule Sami ('bottom-ill' see also *báddnevihke* in Ryd, 2007 [2001]: 224); under such circumstances, the *lichen* and *lichen-rich* types where grazing normally takes place are not accessible to reindeer. Therefore, the *guohtom* takes place in *sämolednam*, or "thicker humus", associated with vegetation types such as *crowberry-heather* or *cowberry* types. In such situations, herders talk about *dajvak guohtom* in Sami ('scattered *guohtom*'). Finally, in the worst cases, Sami herders talk about *tjuohke*, meaning that an ice layer covers the entire grazing area with no scope for accessing ground forage (see also Ruong, 1964; Nielsen & Nesheim, 1979 [1932-1962]; Jernsletten 1997; Ryd, 2001). In such cases, only forests with a large amount of epiphytic lichen can provide forage for reindeer, although nowadays artificial feeding also prevents herds from starving to death.

This comparison demonstrates that it is a mistake to restrict reindeer winter pasture to specific vegetation types because the locations of reindeer winter pasture, or *guohtom*, can shift spatially with time from year to year, and even within a year.

Conclusion

The presented analysis shows that, unlike the system used to classify vegetation types in modern Swedish forestry, the criteria used by

Sami reindeer herders to describe pastures' grazing quality is not simply dependent on the abundance of lichen in a given area of land. Reindeer winter pastures are dependent of a variety of factors – tree height, canopy enclosure, stem density, field-layer, bottom-layer – and the identification of these factors are somewhat similar to Sami and foresters. However, at the higher level of classification, which consists in ordering forest diversity into a classificatory system, their representations of pastures strongly diverse. Based on the thorough observation and understanding of natural phenomena, Sami categories incorporate the multi-dimensional nature of reindeer winter pastures, taking into account the interaction between all the factors that affect foraging resources and snow metamorphism, while the vegetation types recognized by foresters are defined solely in terms of floristic composition. The analysis of folk categories can evidence herders' practices and enable the knowledge that underlies their representation of reindeer pastures to be displayed and understood. Hence, acknowledging categories used by Sami reindeer herders can help forest managers to reconcile conflicts between their activities.

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Abstract in Norwegian / Sammendrag: Klassifiseringssystemet som brukes i svensk skogbruk, har to betydelige svakheter når det beskriver reinens vinterbeiter: inndelingen har lavdekke som eneste avgjørende kjennemerke, og det ser bort fra mulige negative effekter av snødekke. Ut fra etnologiske feltstudier, undersøker denne artikkelen reindriftssamisk klassifisering av reinens vinterbeiter, og sammenlikner reindriftssamenes inndeling med systemet som brukes av skogbruket i ulike klassifiseringsnivåer. På basisnivå der en beskriver adskilte enheter, er det mulig å finne en del overensstemmelse mellom inndelingen brukt av reindriftssamer og bruken i skogbruket. Folk i reindriften skiller mellom de samme faktorene som skogbruksforvaltningens representanter når det gjelder trehøyde, trekronetetthet, stammetetthet, felt- og bunnskikt, men de førstnevnte bruker denne kunnskapen til å vurdere effektene på snø og is og dermed tilgjengeligheten til lavdekket under snøen og isen. Forskjellen i inndeling gjelder nivå to der en ordner den grunnleggende variasjonen av skogkarakteristikker til et klassifiseringssystem. Der blir et misforhold mellom reindriften og skogbrukets presentasjon og klassifisering av beiten fordi de reindriftssamiske inndelingsklassene er ”sammensatte”, dvs. inndelingene innbefatter mange klasser som må kombineres og balanseres før man kan definere beitet. I reindriften inndeling av beitet ser man mer på helheten enn en reint botanisk inndeling som skogbruket benytter. Sammenlikningen av de to klassifiseringssystemene viser at det er umulig å definere et vinterbeite utelukkende ut fra mengden lav. Dette skyldes beitetets mangesidighet og påfølgende romlige og tidsmessige endringer i beitekvaliteten.

