Traditional Ecological Knowledge among Reindeer Herders in Northern Sweden

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Abstract

The present thesis analyses the traditional ecological knowledge about the plants reindeer graze upon among reindeer-herding Sámi. The study was carried out by means of interviews with a total of 22 Sámi reindeer herders from four Sámi reindeer herding communities (in Sweden the term "sameby" is used) in northern Sweden: Gabna, Laevas, Girjas and Udtja. The subjects of the interviews were the plants reindeer graze upon during the summer season (Paper I) and the lichens reindeer feed upon during the winter season together with the reindeer grazing of mushrooms (Paper II). The informants were given the following tasks: a) to identify and name plants either in the Swedish or the Sámi language, b) specify which plants the reindeer eat, c) specify which plants are used during different seasons, and d) describe a good winter pasture. The nomenclature for vascular plants in the Sámi language is limited to a few species, many of them are traditionally used in the reindeer herder's own fare. Other fodderplants the herders have knowledge of are plants that are eaten by reindeer in seasons of sparse pasture, as during the winter, spring and autumn. Accordingly, lichens have a detailed nomenclature in Sámi, where the different species are categorized according to their appearance and habitat, such as jeagil, lahppo and gatna. Grasses in the Sámi language are generally called rássi, but some species of grass are called sitnu. Rássi is the name used for grass and sedges, and also for forbs. Rássi is grazed upon during the summer, while sitnu is grazed upon in the winter as well. The Sámi nomenclature for known fodderplants sometimes have a uniform nomenclature, and this occurs for especially important plants or plants that indicate good pastures, such as *Equisetum fluviatile* which is grazed upon when summer forage is passed, or utilized under the snow during the winter. Apart from these functional groups, Sámi nomenclature for vascular plants is very sparse.

When the reindeer herders characterize good winter pasture they first pay attention to the snow conditions, rather than the amount of lichens. The reindeer herders choose to let their reindeer graze in moist ground areas during early winter, while dry areas are saved until later in the winter. Dry areas are expected to have thinner snow cover than moist areas. Snow quality is of cardinal importance for winter pasture, and the Sámi language has about three hundred words for different snow conditions. This thesis concludes that knowledge about the plants that reindeers graze upon in the summer is sparse among the reindeer herders, but that there is a highly functional terminology for winter pastures conditions. Not only actual forage as lichens is described by a detailed nomenclature, but also snow conditions play a major role in the evaluation of the pastures. It is probably important that the herders preserve their collective traditional knowledge. It is also important that they seek to increase and deepen this knowledge to keep up with the growing demand for more rationalized reindeer herding, and to be able to communicate effectively with other parties in an increasingly arronded reindeer herding pasturage.

Keywords: Reindeer husbandry, pastoralism, forage, range management, scientific knowledge, Sámi terminology, lichens, snow
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Svensk sammanfattning

Följande avhandling analyserar renskötande samers traditionella kunskap om renens födoväxter. Studien utfördes genom intervjuer med totalt 22 renskötare från fyra svenska samebyar: Gabna, Laevas, Girjas och Udtja. Intervjuerna berörde renens födoväxter under sommaren (Paper I) samt svampar och vinterbete av lav (Paper II). Informanterna gavs följande uppgifter: a) identifiera och namnge växter på antingen samiska eller svenska, b) ange vilka växter renen betar, c) specifiera under vilka perioder av renskötselåret olika växter betas, samt d) karaktärisera bra vinterbete. Den samiska nomenklauturen för kärlväxter är begränsad till ett fåtal arter, varav många är sådana som renskötarna traditionellt själva använt i sin kosthållning. Andra foderväxter som var välkända bland informanterna är sådana som nyttjas av renen under perioder då betet är begränsat, dvs under höst, vinter och vår. Därför är den samiska nomenklauturen för lavar mer detaljerad, och olika arter kategoriseras utifrån sitt utseende och växtplats, såsom jeagil, lahppo och gatna. Gräs kallas generellt för rássi, men en del arter kallas sitnu. Rássi är det namn som används för gräs, halvgräs och örter som nyttjas under sommaren. Sitnu inkluderar vintergröna arter som betas även under snön. Den samiska nomenklauturen för kända foderväxter är mest enhetlig för särskilt viktiga växter som indikerar gott bete, såsom sjöfräken som betas på senhösten och vintern. Bortsett från dessa funktionella grupper används få artnamn för kärlväxter i det samiska språket.
Informanterna lade större vikt vid snöförhållanden än faktisk mängd lav när de karaktäriserade ett gott vinterbete. Torra områden förväntades få tunnare snötäcke under vintern än fuktiga. Man valde generellt att låta renarna beta områden som förväntas få mycket snö först och spara torrare områden till senare på vintern, när renarna kan ha svårt att gräva genom snön. Snöförhållanden är mycket viktiga för renskötseln, och samiskan har fler än trehundra ord för snö och snöns relation till renbetet. Min avhandling visar att renskötarna har sporadisk kännedom om de växter som renarna betar under sommaren, men att det för vinterbete finns en mycket utförlig terminologi som inte är begränsad till själva betesväxterna, utan även inkluderar snöförhållanden. Det är förmodligen mycket viktigt för rennäringen att bevara den traditionella ekologiska kunskapen för att kunna hålla jämna steg med de ökande kraven på rationalisering och effektivisering av näringen, och för att kunna ha en effektiv dialog med andra parter som gör anspråk på renskötselområdet.

Contents

List of Publications

This thesis is based on the work contained in the following papers, referred to by Roman numerals in the text:

I Berit Inga & Öje Danell. 2008. Traditional ecological knowledge among Sámi reindeer herders in northern Sweden about vascular plants used by reindeer (*Arctic*, manuscript under revision)

II Berit Inga. 2007. Reindeer (*Rangifer tarandus tarandus*) feeding on lichens and mushrooms; traditional ecological knowledge among reindeer-herding Sami in northern Sweden, *Rangifer* 2/2007, 93-106

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1 Introduction

The reindeer, *Rangifer tarandus* L., has existed in the northern hemisphere for a very long time (Baskin & Danell, 2003). The Sámi people in Fennoscandia and on the Kola peninsula, along with other ethnic groups in Asia, lived by reindeer hunting and began early, at least during the last 2000 years, to keep tamed and domesticated reindeer (e. g. Roung, 1967; Skjenneberg & Slagsvold, 1979 (1968); Hultkrantz & Vorren, 1982; Baskin, 2000). The reindeer, called caribou on the American continent, are not domesticated but are hunted by various indigenous people.

By feeding on lichens in the winter the reindeer has made life possible for people in the harsh environment of the Arctic (e. g. Skjenneberg & Slagsvold, 1979 (1968); Hultkrantz & Vorren, 1982; Syroechkovski & Kuprianov, 1995; Syroechkovski, 1999). Until the 1500's the nomadic Sámi had a few tamed reindeer that were used for transport and milking, while meat was obtained by hunting wild reindeer (e. g. Hultkrantz & Vorren, 1982; Aronsson, 1991; Mulk, 1991). After the sixteenth century and due to a changing economical system, the Sámi people began keeping larger herds of semi-domesticated reindeer (Lundmark, 1989). It is likely that the Sámi people have accumulated a significant amount of knowledge about the reindeer's ecology, first as hunters and later as herders, which is essential to their survival and way of life. I have conducted a series of interviews with Sámi reindeer herders to explore and document the nature of this knowledge.

1.1 Current Reindeer Husbandry in Sweden

Reindeer husbandry requires land and is practised in approx. 50% of the land area in Sweden (*Renbeteskommissionen*, 2001). It is important to note that, when domestication of the reindeer took place in Fennoscandia, the reindeer were already present in the area (Clutton-Brock, 1999). The management strategies builds upon the fact that reindeer are adapted to the environment and have the ability to utilize natural fodderplants (e.g. Danell *et al.*, 1999; Gaare & Danell, 1999; Forbes *et al.* (eds), 2006).

In Sweden there are two types of reindeer husbandry: forest and mountain reindeer herding (Fig. 1). The forest type of herding is carried out in the boreal forest area all the year round. The mountain type uses the mountains during the summer and the boreal forests in the winter. In both reindeer herding systems the reindeer are moved between different areas in order to find new grazing areas and to avoid insects and high temperatures in summer. Sweden hosts the tundra reindeer *Rangifer tarandus tarandus* (Banfield, 1961), which is also known as mountain reindeer. Only the Sámi people are allowed to practice reindeer herding in Sweden (Svensk författningssamling, 1928). During the summer, reindeer herding is prohibited below the Lapland-border (Fig. 2), with the exception of the Torne River Valley and the valley of the River Kalix, the area bordering Finland (Fig. 1). Since 1928 so-called concession reindeer herding is practiced in eight concession reindeer-herding communities in the Torne River Valley below the Lapland border. Here Sámi reindeer herders are given the concession to practice reindeer-herding all the year round in exchange for keeping up to 30 reindeer owned by each of the landowners in the area of concession (Fig. 1; Statistics Sweden, 1999).

The intensity of the contact between the herders and their herd varies with the seasons. It is mainly in the winter (November-April) and during the calving-period (April-May) that the reindeer herders have close contact with the animals and they certainly have observed what the animals feed on during that time. In May during the calving season, the reindeer herders have a close and daily contact with the herd to protect the calving reindeerherd from disturbances (e.g. Svonni, 1983). In the summer, the contact with the reindeer is more sporadic, but takes place when the herders are gathering the herd into calf marking corrals five to seven times during the middle of June to August. In September the slaughter of bulls takes place and after that the reindeer are left undisturbed during the mating-season. During the winter grazing period, that extends from November to

March/April, the herders nearly have daily care of the herd and move it shorter distances to new grazing areas when necessary. In March/April the contact with the herd gets more intensive when the herd is moving to the lower mountains above the birch timberline (e.g. Skjenneberg & Slagsvold, 1979 (1968); Svonni, 1983; Paine, 1994; Kuhmunen, 1968, 2000). This description is mainly for mountain reindeer herding, but can also partly be applied to the forest herding system.

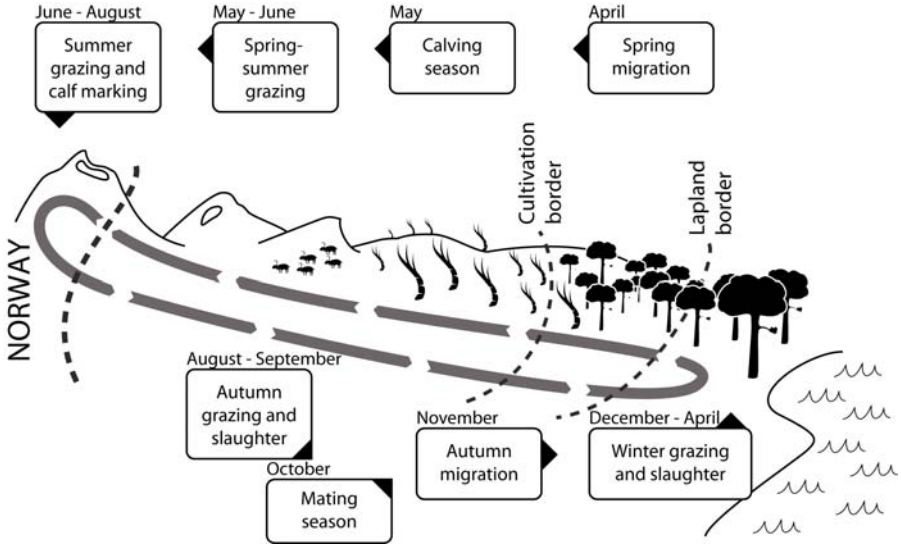

Figure 2. The chart describes how the reindeer herding areas are utilized by mountain reindeer herding Sámi communities. Forest reindeer herding is also migratory, but the reindeer stay in forest areas during the entire year. (Drawing by Jon Mihkkal Inga)

1.2 Traditional Ecological Knowledge

The Sámi people's traditional knowledge of animals and plants in ecological relationships is to a great extent unexplored from a scientific point of view. The majority of studies in modern time have been done by anthropologists (e.g. Manker, 1953; Ruong, 1956, 1967, 1982; Ingold, 1978; Beach, 1981; Paine, 1994), who have studied the traditional use of land and water in connection with reindeer pastoralism (pastoral farming).

Some earlier studies have been made on Sámi nomenclature of vascular plants and lichens. The earliest was Linneaus (2003 (1732)) who during his travels in Lapland had in his documentation of the Sámi people used their words for some of the plants and animals. And 300 years later at the beginning of the 20th century a series of interviews conducted with Sámi

map the Sámi nomenclature for lichens (Nissen, 1921). Nissen refers to collections of Sámi words on lichens and vascular plants made by Qvigstad (1901) and Nielsen (1945 (1912)).

Works in the ecological sphere about reindeer fodderplants were published by e. g. Skuncke (1958, 1963, 1969), Skjenneberg & Slagsvold (1979), Kararev (1968), Leander-Willians (1988), Danell *et al.* (1994) and Mårell (2006), and also published reindeer grazing investigation in the government commission connected with the dissolving of the union in 1905 between Norway and Sweden e.g. Lönnberg (1909) and Holmboe (1912). Researchers have recently begun to use interviews as a complement to conventional methods when investigating the biology of the reindeer and the practice of reindeer herding (e.g. Forbes *et al.*, 2006).

People have lived and acted during millennia only with the knowledge they got verbally from earlier generations, and through their own experiences. This is commonly called a silent or tacit knowledge. Polanyi (1969) wrote, "we can know more than we can tell", and he also defined traditional ecological knowledge (TEK) as knowledge that people have and simply put into practice (Berkes, 1999; Berkes *et al.*, 2000). Thus TEK as a method of doing research also has other terms like indigenous knowledge, local knowledge, Inuit knowledge etc. that are used as a contrast to western science (Berkes, 1999). Grenier (1998) published a guide for research in traditional knowledge where he uses the term indigenous knowledge, and also discusses ethical issues concerning the collection of data for such studies.

The research method TEK was introduced during the 1980's and it has since then been discussed among scientists (e.g. Berkes, 1999; Wenzel, 1999). Several scientists have used this methodology in order to explain ecological connections and long-time trends (e.g. Freeman, 1985; Berkes, 1987; Helander, 1996; Ferguson & Messier, 1997; Huntington, 1998; Thorpe, 2000; Usher, 2000). People that are directly dependent on natural resources notice changes in nature in ways that are often overseen by established scientific methods. Standard ecological investigations are valuable, but can with a few exceptions (e.g. paleoecology) only show the current state of the system, not its history. To call it traditional knowledge is not the same as to call it static knowledge, but rather accumulated knowledge that has been operatively tested and refined by generations of people who have been dependent on this knowledge for their survival (e.g. Grenier, 1998; Berkes 1999). Therefore researchers who are interested in changes in nature will benefit greatly from interviews with indigenous people.

Fikret Berkes (1999) is one of the researchers who promoted the term traditional ecological knowledge (TEK) in the 1990's, and he has discussed

and written extensively about how we should relate to this concept. According to Berkes (1999) TEK contains a strain of ethnobiology: ”The study of traditional ecological knowledge begins with the study of species identification and classification (ethnobiology) and proceeds to considerations of peoples’ understandings of ecological processes and their relationship with the environment (human ecology)”. Berkes (1987) also divided TEK into three levels, in a “knowledge - practice – belief complex”. The first level is knowledge on surrounding animals and plants and also on the behaviour of animals, the second level is to practice the knowledge in their livelihood as hunters, fishermen or herders, and the third level is the belief system in which events are interpreted in some way. My study mainly deals with the TEK in the knowledge – practice sphere and not in the belief complex.

In this study the reindeer herders stand in focus with their accumulated knowledge about the reindeer ecology and this can be seen as a complement to knowledge derived from western scientific knowledge.

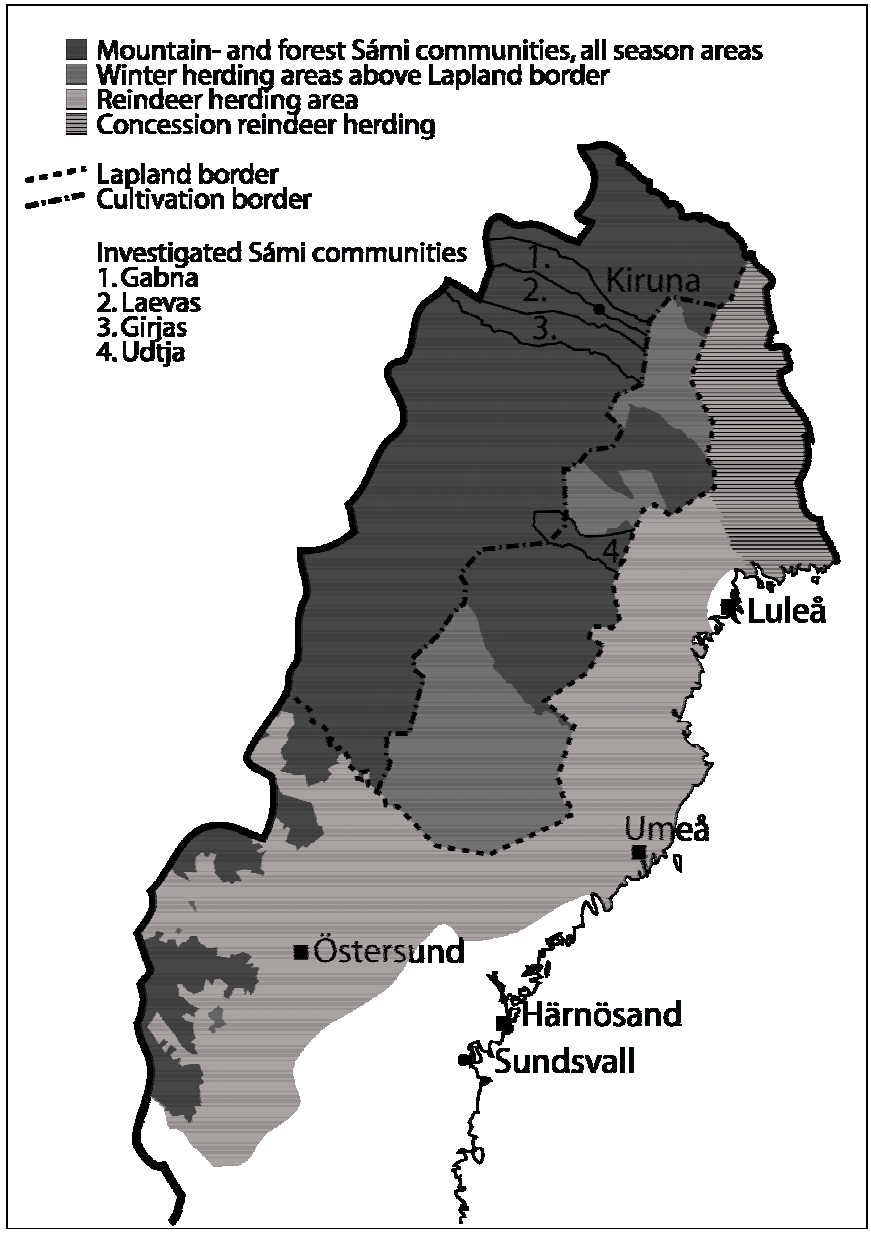

Figure 1. The map covers the Swedish reindeer herding area. The different reindeer herding systems are marked; mountain- (33 communities), forest- (10 communities) and concession reindeer herding (8 communities). The Lapland regional border was established when Norway and Sweden separated in 1751. The cultivation border was laid out in 1868 to protect the reindeer herding areas from exploitation by farming and settlement. The four Sámi communities in this study are marked. Map data from Renbeteskomissionen (2001). (Drawing, Jon Mihkkal Inga).

2 Aims

The purpose of this investigation is to look at the extent of current traditional knowledge among Sámi reindeer herders about vascular plants and lichens that are considered to be important forage plants for reindeer in the scientific literature. My hypothesis is that there is a long tradition of ecological knowledge among the Sámi people, and that the ability to recognize and name the different plants that reindeer feed on is vital for the herders. Interviews were used to identify vascular plants, lichens and mushrooms that reindeer use and then specify when they are being grazed during the year (Papers I and II). The informants were also asked to characterize a good winter grazing area (Paper II).

I also wanted to know if reindeer herders do have any special taxonomy or terminology for plants, which differs from the scientific descriptions. The investigation refers to conditions in four reindeer herding areas used by four different Sámi communities in northern Sweden.

The aim of my study is to investigate the knowledge among reindeer herding Sámi about the reindeer's summer forage plants (Paper I) as well as winter forage plants (Paper II).

3 Study Design

3.1 Study Area

The reindeer herders who were interviewed were members of three mountain Sámi communities (Gabna, Laevas and Girjas, 68°N), and one forest Sámi community (Udtja, 66°N) in northern Sweden (Fig. 1). A Sámi community is an association of reindeer herders, and membership of a Sámi community is a prerequisite for grazing reindeer within the reindeer herding area belonging to that Sámi community. The mountain Sámi reindeer herding areas extend from the Norwegian border in the west with bare mountain into the boreal coniferous forest in the east. The mountain herding communities practise a migratory reindeer herding, grazing in the mountains during the summer and in the forests in the winter. The reindeer herding in the forest Sámi community is more sedentary within the boreal forest all the year round, although different parts of the landscape are used during the different seasons.

3.2 Material and Method

The two papers were based on interviews with 22 reindeer herders, in three mountain Sámi communities (Gabna, Laevas, Girjas) with 15 male and 1 female, and one forest Sámi community (Udtja) with 5 male and 1 female informants. The first rounds of interviews (interviews I–III, 1999–2000) were held with 17 informants from four Sámi communities (Papers I and II). In the second round of interviews (interviews IV–V, 2001–2002) two mountain Sámi communities (Gabna and Laevas) were involved with 9 informants in the interviews (Paper II).

The informants were all born in 1950 or earlier, and have had their livelihood in reindeer husbandry (Paper II: Appendix). The reason for choosing older herders was that they were expected to have got their training in reindeer herding, when education in biology and plant ecology was less commonly offered as a means for herder professional improvement. The interviews were held mostly in the herders' homes and in the language of the informants' own choice, Swedish or Sámi. Nineteen out of the 22 informants could speak Sámi, and 9 of them chose to speak Sámi, but all the informants who spoke Sámi used Sámi terminology in their responses. The interviews were held in an informal tone and usually developed into discussions about fodderplants and grazing conditions. This occasionally revealed additional knowledge that would not have been illuminated in simple question-and-answer-sessions.

Each informant was given three main questions: a) which Sámi names were used by the reindeer herders for vascular plants, lichens and mushrooms; b) when during the year did the reindeer feed upon them; and c) which species did the reindeer prefer (Papers I and II).

Interviews I–III were recorded on tape and transcribed by people who spoke both Sámi and Swedish. This material was then analysed using the QSR NUD*IST software (1997), which was used for sorting words and terms to get a comprehensive overview of the collected material. Interviews IV–V were documented both by notes and recording on tape.

The answers concerning the informants' identification of plant taxa and their use by reindeer were compiled as categorical responses in response classes: "identified by name", "identified without name", "not recognised", and "grazed", "not grazed", "not known whether grazed or not", "use not addressed by respondent", respectively. Possible associations of reindeer herding communities and responses were tested for all species merged, for groups of species, and for some specific species where differences between herding communities could be expected a priori, using Fisher's exact test in the FREQ procedure of the SAS statistical software (SAS Institute Inc. 2002) (Paper I).

To get information about what characterizes a good winter grazing area, two different experiments were carried out during the second round of interviews (IV–V) (Paper II, Table 1). In the first experiment the informants had to rank seven plant community boxes (18 cm x 18 cm) according to the preference by reindeer. To test how well the rankings coincided with each other, the results were tested with the Kendall coefficient of concordance (Siegel & Castellan, 1988).

In the second experiment, the informants were shown two photographs from two different types of winter pastures (Paper II, Fig 2A-B). The informants were asked to value the two habitats as winter grazing areas with the assumption that both had the same amount of fodder (both in quality and quantity).

The scientific nomenclature follows Santensson *et al.* (2004) for lichens and other plants are classified according to Mossberg & Stenberg (2003). The Sámi names are underlined and follow the Northern Sámi spelling, unless indicated otherwise. The spelling for the Northern Sámi names (NS) follow Svonni (1990) and Lule Sámi (LS) spelling follows Spiik (1994).

4 Results

4.1 Identification of Plants

In seasons, as during the autumn-, winter- and spring-time, with shortage of available forage for reindeer the herders had a very good knowledge of which plants the reindeer grazed on. Some species are especially important during this period of sparse forage for the reindeer. Examples are *Equisetum fluviatile,* that can be grazed even when the snow covers the ground (Paper I: Fig 3e), and on the wetland in the spring (May – June) is *Eriophorum vaginatum* (Paper I: Fig 3d) an early protein-rich fodderplant after the poor winterdiet. Both species were well known and therefore have uniform names (Paper I: Table 2). The knowledge about dwarf shrubs showed a difference between mountain and forest herding communities. Herders from mountain herding community had mainly a clear understanding of which, when and where the dwarf shrubs are consumed by reindeer. This is valid especially for *Empetrum nigrum* ssp. *hermaphroditum*, but also for *Vaccinium myrtillus* and *V. vitis-idaea* ssp. *vitis-idaea* (Paper I: Fig 3a and Paper II: Table 4).

Plants that the reindeer herders used in their own fare were easily identified and they had also given a similar or identical Sámi name for it. Berries as *Vaccinium myrtillus*, *V. vitis-idaea* ssp. *vitis-idaea* and *Rubus chamaemorus* are all picked and eaten by all the informants (Paper I). Forbs such as *Angelica archangelica* ssp. *archangelica* and *Rumex acetosa* are also widely known by Sámi people and these species have traditionally been used in their diet (Paper I). Other plants that were identified by the Sámi because of their own use of them were *Carex rostata* and *C. aquatilis* ssp. *aquatilis* that earlier, but even to some extent today, were used as shoe-hay (Paper I). Trees and shrubs (*Betula* and *Salix)* were mainly identified with the same

name, but not always according to if it is eaten by reindeer (Paper I). The informants did, for example, not separate species of *Salix*, although they have different names for *Salix*, but one of the informants made a difference between dead or living *Salix* (Paper I). In this case the willows (*Salix*) have been identified as being good for smoking reindeer-meat or for making up an ordinary fire.

Lichens are best known and the herders are able to distinguish different lichen species (Paper II: Table 2). The herders also reported which of the lichens are preferred and which are not preferred by reindeer (Paper II: Table 3 and 4). The lichen that is preferred is *Cladonia* spp., and those not preferred are *Nephroma* spp. and *Stereocaulon paschale*.

Mushrooms were not known at the species level at all by the interviewed reindeer herders. However, the informants were sure that reindeer are very fond of it and they could tell when the reindeer consumed mushrooms during the year (Paper II: Figure 3b-c).

4.2 Traditionally used Nomenclature of Plants

Similar or identical names are given when the Sámi themselves use the species. Examples are berries from dwarf shrubs and forbs used in their diet, and trees or shrubs used for smoking, fire or timber (Paper I). Grasses did not have names at the species level but there is a clear and uniform nomenclature for a group of grasses called sitnu (*Deschampsia flexuosa* ssp. *flexuosa, D. alpina, Festuca ovina* and *Poa alpina*). All the informants did identify the grasses sitnu and 11 of them also gave descriptions that confirmed the name they had used for these specific grasses (Paper I: Table 2, Fig 3c). The grasses they called rássi include different species of grass and forbs that reindeer graze during the summer (Paper I: Fig 3b-c). It is obvious that they distinguish between sitnu and rássi (Fig 3).

The nomenclature for lichens was very distinct and was also mainly used by the reindeer herders. According to all the informants, lichens are the most important fodder for the reindeer's welfare during the winterseason and in view of this importance, the informants also have a uniform nomenclature (Paper II: Table 1 and 2). Among the reindeer herders the lichen terminology is clear in relation to habitat and appearance: jeagil (NS) or visste (LS) for fructiose lichens on the ground, lahppu for tree living pendulous lichens and gatna for foliose or crustose lichens that live on trees or on rocks (Paper II: Table 2).

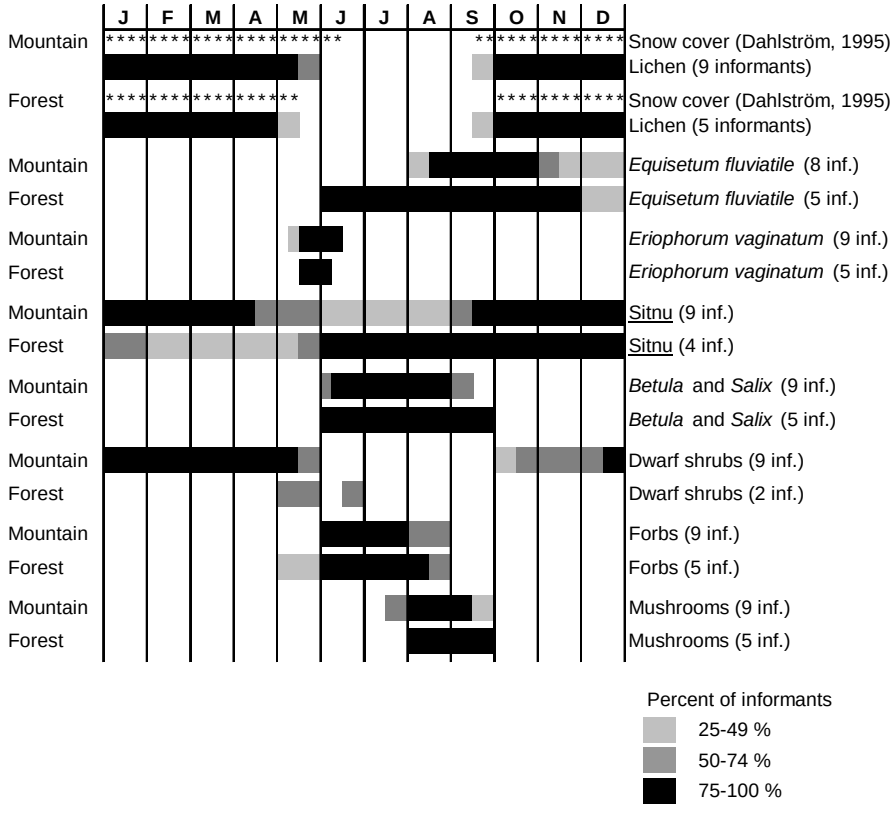

Figure 3. Information on when the informants from the reindeer herding communities investigated thought that the reindeer graze upon certain fodderplants (Papers I and II). The mountain communities are Gabna, Laevas and Girjas, and the forest community is Udtja. The shading of the lines represent how many percent of the herders that claimed the plants were grazed regularly. Sitnu are grass like *Deschampsia flexuosa* ssp. *flexuosa, D. alpina, Festuca ovina* and *Poa alpina*. Dwarf shrubs are *Empetrum nigrum* ssp. *hermaphroditum, Vaccinium myrtillus, V. uliginosum* ssp. *uliginosum* and *V. vitis-idaea* ssp. *vitis-idaea*. This investigation excluded dwarf shrubs like *Salix herbacea*.

4.3 Seasonal use of Fodderplants

The informants from the mountain and forest herding communities largely agreed when asked to specify during which periods the reindeer feed on specific plant species/groups (Fig. 3). Somewhat different opinions were expressed that may be explained by diverse reindeer use of habitat during the year. As an example *Equisetum fluviatile* seem to be grazed during different periods in the two types of herding communities. In the forest herding community most herders claimed that it was grazed from June to the end of the year, but in the mountain herding communities they claimed that it was grazed from the middle of August to the end of the year. The explanation is perhaps that the reindeer in the forest community use summer areas where *E. fluviatile* is found, since the mountain community reindeer arrive in August at the earliest to habitats with *E. fluviatile*.

Sitnu is the Sámi name of a group of grasses with special characteristics. In some literature sitnu is claimed to be *Deschampsia flexuosa* ssp. *flexuosa* (Warenberg et al., 1997), but when the informants were given their description of sitnu it is quite clear that it is not only one grass that is called sitnu (Paper I). Most of the mountain community herders claimed that the sitnu-grasses were grazed during the winter season and almost at the same time as lichens. On the other hand, most forest community herders claim that sitnu was grazed also during the summer and until December (Fig. 3). The mountain community herders, compared to herders in the forest community, seem to assign a higher value on sitnu as a winter fodder. One herder from the forest community said that the reindeer grazed sitnu and leaves from *Betula* and *Salix* in the summer (Paper I: Fig. 2). It is obvious that reindeer herders classify sitnu as grass with high fodder value all the year round.

4.4 Ecological Characteristics of Grazing Areas

The winter grazing season represents a decrease in the amount of green fodderplants with high protein content. The reindeer has solved this nutrition problem by choosing to graze on lichens with a high content of carbohydrates. Further, the reindeer is also adapted to a lower food intake during winter by catabolizing its accumulated energy resources from its body fat and, if necessary, muscle protein (Paper II).

The discussions that arose during the experiment where the informants were to rank seven boxes of different plant communities, gave some information on what the reindeer herders consider to be important features of good winter foraging areas (Paper II: Table 1). First they mentioned to

what extent the lichens covered the ground and rated the boxes after that. Next, they discussed the snow cover, how deep it might be and if certain boxes represented areas where the snow is easy to dig for the reindeer.

When the two photos, one of flat ground with young trees and one of a more hilly area with bigger trees, were scrutinized the reindeer herders focused on the snow cover in their discussion (Paper II: Fig. 2 A-B). The reindeer herders agreed that a winter grazing area in an old *Pinus sylvestris* forest was better than in a young one or forests with other trees, such as *Betula* spp., *Salix* spp. or *Picea abies*, which normally grow in more moist ground than *Pinus sylvestris*. Two of the herders also ranked the seven boxes according to how moist the area was presumed to be and they also gave recommendations on the optimal use during the winter. In these recommendations a moist area will be utilized in early winter (October – January) and a drier area during late winter (January – March). None of the other informants had differing opinions on this suggested crop rotation of grazing areas.

5 Discussion

This study concludes that detailed knowledge about specific species of grazing plants is not essential for reindeer herding. It appears that the reindeer herders use certain plants as "indicators" for evaluating the quality of forage in an area. In general, the informants appeared to have a more precise knowledge about vascular plants and lichens that are used mainly during periods of sparse forage, such as in the winter. This also coincides with the period when the intensity of the contact with the herd is highest during the year.

Instead of following the established scientific method when investigating the ecology of the reindeer, I have chosen to conduct interviews with reindeer herders about their knowledge on what the reindeer feed upon. In this method of investigation the reindeer herders are the material, and it is therefore crucial that they are chosen with care so that they form a representative group for all reindeer herders' knowledge. The selection of the informants was carried out partly in collaboration with the chairmen of the reindeer herding communities, and some of the informants were chosen by me based on my personal knowledge of these persons. One important criteria imposed on the choice of informants was that they had not participated in similar studies to assure that all material collected in the interviews stems from true traditional knowledge. Statistic analysis of the results in Paper I and II suggests that the group of informants chosen is sufficiently representative.

The purpose of this work was to investigate the nature and extent of the reindeer herders' knowledge about the reindeers' fodderplants. It was important to eliminate the differences that could appear in different locations and at different times to produce as equivalent interview conditions as possible. Hence I opted to show pictures of plants from Warenberg *et al.* (1997) (Paper I) along with a number of living specimens of lichens

(Paper II), rather than interviewing the reindeer herders out in the field. It is possible that the reindeer herders could have done better if they were to see the vascular plants in their natural habitat instead of being asked to identify them from pictures. However, the procedure chosen allowed for a greater number of informants since it did not require the careful selection of locations and precise timing. An option would have been to bring all 22 informants to one location at the same time, but it was unfeasible for such a large group and is unlikely to have produced more reliable data.

In Paper I, which deals with summer grazing, a surprisingly small number of species of grazing plants were recognised with a uniform nomenclature. Such nomenclature would clearly be an advantage when knowledge is passed on to the next generation (e. g Berlin, 1992; Helander, 1996). One example where all the informants used the same nomenclature is a group of grass species, *Deschampsia flexuosa* ssp. *flexuosa*, *D. alpina*, *Festuca ovina* and *Poa alpina*. These species preserve their green colour under the snow and are suitable for grazing in the winter. All the informants identified these species as sitnu (Paper I: Table 2). According to Qvigstad's (1901) dictionary of Sámi plant names, the word sitnu was used as a common name for grass species, such as *Deschampsia flexuosa* and various species of *Festuca* (Nielsen, 1979).

About lichens the reindeer herders had a considerably more detailed knowledge, and could differentiate and name very similar species such as *Cladonia rangiferina/arbuscula/mitis* and *C. stellaris*. The informants also had a name for *Stereocaulon paschale* that according to the reindeer herders is not preferred by reindeer (Paper II). Names used for lichens are a description of the lichen habitat and their appearance: fructiose on the ground, pendulous in trees, and crustose or foliose on rock or bark. The reindeer herders of today still use the same names for categorization of lichens (Inga, 2007) as was described in Nissen's (1921) study conducted in the early 1900's. This kind of nomenclature is functional when used in the every-day work of the herders. Keeping a homogenous and precise nomenclature for lichens greatly simplifies the exchange of information. Combined with an effective way of communicating snow conditions, the reindeer herders have a well-developed tool for conveying knowledge about the vegetation and condition in different areas.

Instead of extensive knowledge of different species of plants, the reindeer herders have arranged the plants in functional groups such as rássi and gieganjulla (Paper I: Fig. 3b and 3d). The word rássi is used for anything that the reindeer feed upon during the summer, such as various species of grass and herbs. Gieganjulla is used for plants that grow early in the summer and

are important to the reindeer from the end of May to the middle of June. Some particularly important species as *Equisetum fluviatile*, which is grazed when forage is declining towards the end of the summer, have specific names that are regularly used by the herders. The grouping of lichen in jeagil, gatna and lahppo is also functional because it conveys information about the characteristics and habitat of the lichens (Paper II). The herders communicate properties of pastures simply by mentioning the kind of lichens that are present.

In the experiment with the seven boxes of vegetation samples, the boxes containing much lichen were always identified as the best pasture (Paper II, Table 1). But, the amount of lichen was seldom mentioned by the herders when they were asked to explain their choice. Instead, most of the informants claimed to have made their choice by considering whether the sample came from a dry or a moist ground area, and by estimating how deep the snow would be in the area during the winter. Depending on the snow condition an area is selected for grazing at different times during the winter. The informants said that they would choose to first use areas where the snow is expected to become deep, and save the areas that are expected to have a more shallow snow coverage for later usage in the winter, when there might only be a few of places where the reindeer can dig through the snow. Contrary to my assumptions, the areas with the thickest lichen were chosen for grazing early in the winter while areas with thinner lichen were saved for later in the winter. The informants simply assumed that areas with more lichen would get more snow in the winter. When making their choice the informants also considered that areas with large amounts of lichen are found in moist ground areas while the pine forests are drier and have a sparser layer of lichens on the ground. Using this principle when selecting which areas to use first in the winter may also serve other purposes. Most notable is the fact that areas with a thinner coverage of lichen are more sensitive for disturbance (e. g. Crittenden, 2000). Saving these areas for grazing later in the winter, when there is more snow, will also help preserve them from excessive usage. This was not mentioned during the interviews when the boxes were rated, but I think that it might be a form of silent knowledge. If so, it is a practice that is simply used without being mentioned (Polanyi, 1969).

In literature it is easy to find 300 Sámi terms for snow in relation to reindeer grazing and also words that describe snow for people and animals to travel on (Jernsletten, 1997; Ryd, 2001). From that perspective, it is not surprising that the herders were more inclined to talk about snow conditions than the quantities of lichen (Paper II). However, the purpose of my studies

was not to shed light on the various Sámi words for different forms of snow, but rather to understand how the quality of the snow affects the reindeer's ability to find food in the winter. Paper II illustrates the interest and knowledge about this subject among the reindeer herders.

The knowledge about the reindeer's ecology among the reindeer herders consisted consequently not mainly of knowledge about different plants that reindeer feed upon. In literature about reindeer herding, where Sámi terms are encountered, a relatively small percentage are names for reindeer fodderplants (e.g. Ruong, 1964, 1968; Collinder, 1984; Eira, 1984; Jernsletten, 1997). Common plant names in Sámi languages were recorded by e.g. Linneaus, 2003 (1732); Qvigstad, 1901, but in some cases there is a great uncertainty about what plants that they actually meant. Older reports (e. g. Linneaus, 1732) show that historically the Sámi had best knowledge about vascular plants used in their traditional fare, but then older works are more concerned with how people survived in the harsh environment of northern Scandinavia. I conclude that this is also true for today's reindeer herders, and that other vascular plants that are well known by the reindeer herders are species that are important to reindeer during seasons of poor forage. Historically, and in the beginning of the 1900's, the reindeer herders had a closer contact with the reindeer than they have today. This should probably affect the number of fodderplants that have specific names. Only lichens and a few common plants are mentioned in older literature and these species are also known by the the reindeer herders in this study. Most of the people, who wrote about the Sámi in the 1600's and the 1700's, had little or no experience of systematics for plants (Shefferus, 1956 (1674); Magnus, 1982 (1555); *Berättelser om samerna i 1600-talets Sverige*, 1983).

Those who wrote about northern Sweden in the 1600's were mostly focused on the Sámi people and their use of the reindeer, but notes of the reindeers' grazing plants were also made in a few documents (Tornaeus, 1983 (1673); Lundius, 1983 (1674-1679). In the 1700's Carl Linneaus travelled to Lapland in Sweden to study its natural history, but he also studied the Sámi people. Because of this he can be called our first ethno-biologist. Thanks to his curiosity we know what names the Sámi people used for some species of plants and animals in the 18th century. Many of the names found in the works of Linneaus are still in use by the herders interviewed in this study (Linné, 1905 (1737); Linneaus, 2003 (1732). The plants that are mentioned in older writings are the same as the plants that today's reindeer herders know well and have specific names for, and in many cases these are the plants that are used as "indicator species".

Species that can be denoted "indicator species" are those that reindeer herders identify as grazing plants and that are foraged upon during seasons when the reindeer herders frequently move their herd between different grazing areas. Species that reindeer herders commonly have as a sign of a good pasture are lichens on trees and on the ground, as well as the sitnu grass species, and also *Equisetum fluviatile* and *Eriophorum vaginatum*, which are all grazed outside the vegetative period, from September-May. During the vegetation period (June-August), the reindeer herders are less concerned with the grazing plants, since forage is normally more than adequate and easily available to the reindeer. This explains why knowledge of common summer plants is comparatively limited.

It turned out that it is not an easy task to make a distinction between traditional and scientific ecological knowledge. Since Linneaus, scientific methods have changed and today biologists have verified what reindeer graze upon without asking the reindeer-herding Sámi. Young herders can thus consult literature to learn about the reindeer ecology. When the informants were asked how they once learned about specific plants, they mostly answered that they had "thought themselves". This is understandably a hard question to answer as most of this study concerns knowledge that the individual herders have had for a very long time. I can only conclude that there is no definite way to distinguish traditional knowledge from scientific knowledge. My opinion is that the knowledge about the reindeer, their diet and their life — whether it is founded on scientific knowledge or stems from a long tradition of practical reindeer herding — is traditional knowledge as long as it is used as a tool by the reindeer herdsmen.

Large parts of the herders' knowledge consist of detailed information about their reindeer herding areas and much of this knowledge is thus only applicable to a limited region. There are also differences between forest- and mountain reindeer herding that stem from the different biotopes that are used, especially during summer. In this case TEK can be said to be very local, as Ruddle (1994) call it: "local knowledge". Thorpe (2000) prefers the term "Inuit ecological knowledge" to TEK because she wants to focus on whom the knowledge belongs to. It would be in line with her to call the TEK in my research "Sámi knowledge", or to be more precise: "reindeer herders' knowledge".

The reindeer herders have acquired their knowledge about the reindeer from their parents and elders, but it is also the fruit of their own experiences and of their own reading. In this context it is more important to observe that the herders have this knowledge, than it is to speculate about the origins of the knowledge. Today the knowledge of reindeer herding Sámi people

can be called traditional ecological knowledge, with the emphasis given to the word knowledge. All this ecological knowledge is used by the herders to take care of their reindeer herd in the best and most effective way. Thus the reindeer herders' knowledge is specialized and professional. If the use of the Sámi language diminishes, many significant ways of describing the environment, the condition of the snow and the behaviour of the reindeer will be lost (e. g. Helander, 1993; Heikkilä, 2006). That is why it is important to document the Sámi-speaking herders' knowledge about the reindeer, a knowledge that researchers at the beginning of the 20th century took for granted.

6 References

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