

# Reindeer (*Rangifer tarandus tarandus*) feeding on lichens and mushrooms: traditional ecological knowledge among reindeer-herding Sami in northern Sweden

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*Abstract:* The study was performed in four reindeer-herding districts (Sami villages) in northern Sweden. Reindeer herding Sami, born in 1950 or earlier, were interviewed about reindeer foraging behaviour on lichens and mushrooms, especially relating to non-summer grazing habits, and about characteristics of a good winter feeding ground. The informants claimed that lichens are preferably grazed in the wintertime, but that they also may be eaten in the summertime when the weather is cold and humid. Mushrooms were chosen in the autumn months August and September, but according to some informants mushrooms may also be eaten during late autumn (from Oct.) when frozen and under the snow. The reindeer herders had different names for lichens, which in general terms describe their appearance and habitat. For mushrooms they only used one Sami name. Ground lichens preferred by reindeer are *Cladonia* species, while the nitrogen-fixing lichen species such as *Nephroma arcticum* and *Stereocaulon pascale* were said not to be preferred by the reindeer. Snow conditions are very important, and the less snow (and the softer it is), the better. Habitats where reindeer herders know from experience that snow conditions tend to be problematic, e.g. in moist and open areas with small trees, are used early in the winter (Oct.–Jan.), before too much snow has accumulated. A good winter grazing area should have lichens. It is preferably a dry pine (*Pinus sylvestris*) forest heath with large, old and wide-crowned trees to shelter the ground from snow and thereby ease the cratering by reindeer.

**Key words:** foraging ecology, fungi, lichens, reindeer, Sami terminology, snow, Sweden, winter grazing.

**Rangifer**, 27 (2): 93-106

## Introduction

The reindeer (*Rangifer tarandus*) is adapted to severe winter conditions (e.g. Gaare, 1968; Skjenneberg & Slagsvold, 1979 [1968]; White *et al.*, 1981; Leader-Williams, 1988) and lives in a variety of cold climate environments in the boreal and tundra parts of the northern hemisphere. In general, ground-grazing herbivores have difficulties in winter, when vascular plants are rare or hidden by hard, deep snow. To face these difficulties reindeer migrate to areas with smooth and less snow (Telfer & Kelsall, 1984), and if

lichens are available in the winter grazing area, they change their diet from being dominated by vascular plants such as grasses, forbs and shrubs in summer to a more lichen-dominated forage during winter time (e.g. Skuncke, 1969; Skogland, 1978; Skjenneberg & Slagsvold, 1979 [1968]; Boertje, 1984). Few other animal species have preferences for lichens and most species only have a limited ability to digest them (White, 1975). Lichens are in general low in protein content, high in carbohydrates and have



Fig. 1 The four investigated Sami reindeer herding districts. The map is based on Renbeteskommissionen (2001) and Kemppainen *et al.* (1997).

high digestibility (e.g. Gaare, 1968; Nieminen & Heiskari, 1989; Storeheier *et al.*, 2002a). Herbivores may to some extent avoid ingesting high-protein food during the winter since the diet results in increased water demand for catabolism of protein and excretion of urea (e.g. Cameron & Luick, 1972; Fancy & White, 1985; Storeheier *et al.*, 2002b). A characteristic of reindeer is its ability to use energy-rich lichens (e.g. Holleman *et al.*, 1979; White, 1983; Asplund & Nieminen, 1989; Danell *et al.*, 1999). Due to this, the reindeer's use of lichens is probably not only a question of availability.

During the summer and autumn the reindeer graze on protein-rich vegetation and accumulate energy and protein reserves for the winter (e.g. McEwan & Whitehead, 1970; Reimers, 1980; Helle & Kojola, 1994). In August and September the fruiting body mushrooms become an important source of protein (Boertje, 1990).

Information on adequate Sami knowledge in botany and foraging behaviour has also earlier been gathered by scientists. During his traveling in Lapland as a young student (1732), Carl Linneaus (Carl von Linné) collected ethno-biological data, such as the Sami names for a selection of plants and how the Sami utilized some plants (Linneaus, 2003 [1732]). In Norway at the beginning of the 1900s, Nissen (1921) made interviews with reindeer herders from Finnmark, Troms, South-Trøndelag and from the Swedish county Västerbotten about Sami nomenclature on lichen.

In his work on reindeer grazing plants, Nissen also referred to collections of Sami words on lichens and vascular plants made by Qvigstad (1901) and Nielsen (1912). In Sweden, Rounq (1964), who was Sami himself and familiar with Sami culture, published results based on interviews concerning how snow conditions affected pasture, as well as a small dictionary of various words that described snow and snow conditions in the Sami language. Lönnberg (1909), Skuncke (1958, 1963, 1969), Skjenneberg & Slagsvold (1979 [1968]) and Kararev (1968) have reported on the food plants grazed by reindeer, and their reports are probably also based upon the common knowledge of reindeer herders (although this is not directly stated) in addition to scientific investigations.

My study (study districts, see Fig. 1) focuses on what reindeer herders know about what reindeer forage during winter. In the winter the reindeer herders move the herd between different foraging areas, but in the summer the reindeer mostly roam without any influence from humans except when the herd is gathered for calf marking. I expected that reindeer herders would have detailed knowledge about the foraging behaviour of reindeer during the winter, when they generally have close contact with the animals.

During the last decades, interviews as part of ecological research have become more accepted (Ferguson & Messier, 1997; Huntington, 1998; Berkes *et al.*, 2000; Thorpe, 2000; Usher, 2000). According to Berkes (1999), "The study of traditional ecological

knowledge begins with the study of species identifications and classification (ethnobiology) and proceeds to considerations of people's understandings of ecological processes and their relationships with the environment (human ecology)".

The present study is based upon interviews with reindeer-herding Sami in northern Sweden.

My aim was to describe the traditional ecological knowledge of the Sami herders concerning reindeer feeding on lichens and mushrooms, and the characteristics of good winter grazing areas.

## Study area and methods

Interviews were carried out during 1999–2002 in tree mountain Sami villages (Gabna, Leavas and Girjas, 68°N), and one forest Sami village (Udtja, 66°N) in Sweden (Fig. 1). The mountain villages extend in a northwest-southeast direction 140–175 km from the Norwegian border to east of the so-called cultivation border. West of this border the Sami have the right to herd their reindeer all year long (Mörner, 1982). The study area thus extends from the alpine areas in the west, through the lower slopes covered by mountain birch, *Betula pubescens pubescens* and *B. p. tortuosa*, to the boreal coniferous forest, where mainly lichens, mosses and dwarf shrubs cover the ground. At lower altitudes and along the waterways there are wetlands with *Salix* spp. and other deciduous woody species mixed with conifers. The ordinary winter grazing lands (Nov. to Mar./Apr.) of the mountain villages are located in the coniferous forests, mostly east of the cultivation border. The district of the forest Sami village Udtja lies within the boreal coniferous forest. Their winter pastures have roughly the same characteristics as the mountain Sami villages. Except for a few protected areas, intended for nature conservation and military purposes, the coniferous forests are used for commercial forestry. In the forest Sami village, snow generally covers the ground from 1 October to 15 May, and in the northernmost mountain Sami villages there is snow from 15 September to 15 June (Dahlström, 1995), but there is variation in the length of the snow cover period between years and habitats.

There were 370 members (herders, reindeer owners) in the four Sami villages (Gabna, Leavas, Girjas and Udtja, 1999), and 204 were born in 1950 or earlier (O. Ekström, pers. comm., 1999). Among the latter, 20 men and two women were chosen as informants with the help of the chairmen (Appendix). Besides age, the criteria used were that they were raised in reindeer-herding families and either still were or had been active reindeer herders, to get a group of informants who were experienced and self-taught reindeer herders. Additional requirements were that they

had not participated in a similar study before and agreed to participate in the present investigation. Particular interest in plants per se was not requested. The interviewer did not influence the choice of informants beyond the definition of the selected criteria (Appendix).

To make the interviews as informal as possible they were carried out in the informants' homes, where other family members could participate as well. Each informant was given the same questions, and to avoid guessing, they did not have to answer if they had any doubts. I asked a) which Sami names are used by the reindeer herders for lichens and mushrooms; b) when is the reindeer feed upon lichens and mushrooms; c) which lichens and mushroom species do the reindeer prefer; and d) what are the characteristics of a good winter grazing ground. The questions were quite simple and the answers were given in the form of a conversation. The informants could choose the language, Sami or Swedish, for the interview.

In the first interviews (I–III; 1999–2000), 17 informants from the four villages participated (Appendix), and questions about lichens and mushrooms were asked. The second round of interviews about winter grazing conditions included only Gabna and Leavas Sami villages (IV–V; 2001–2002). Nine informants participated and five of them had taken part in the first round (Appendix).

Interviews I–III were recorded on tape and transcribed by people who spoke both Sami and Swedish (except for one informant where only notes were allowed). This material was then analysed using the QSR NUD\*IST software (1997). Interviews IV–V were documented both by notes and recording on tape.

Each informant was given three main questions, the first three (a–c) cited above. For each interview the informants had access to dried specimens of the following lichens: *Alectoria sarmentosa*, *Bryoria fuscescens*, *Cetraria nivalis*, *Ce. islandica*, *Cladonia arbuscula*, *Cl. rangiferina*, *Cl. stellaris*, *Cl. pyxidata*, *Cl. uncialis*, *Hypogymnia physodes*, *Parmelia centrifuga*, *P. olivacea*, *P. saxatilis*, *Stereocaulon pascale* and *Rhizocarpon geographicum*. The informants could refer to the lichen samples during the interviews I–III.

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). In the first experiment the informants had to rank seven plant community boxes (18 cm x 18 cm) according to the preference by reindeer. The boxes contained different plant communities with different amounts of lichens and were taken from a nearby pine (*Pinus sylvestris*) forest. The boxes L28, L33 and L34 were collected in areas with some occurrence of birch trees (*Betula*). The boxes contained

**Table 1.** Ranking of winter grazing areas for reindeer by nine reindeer herders in northern Sweden on the basis of plant communities visualized in 18 cm x 18 cm "plant community" boxes with lichens, dwarf shrubs, mosses and plant litter. The cover of plant groups in the boxes is given in per cent. Plant species included are mentioned in the short description and species occurring in very small amounts are within brackets. When the informants regarded the box to be uninteresting as winter grazing pastures, "no" is indicated, and is considered to be in the last order of preference. Five of the nine informants ranked the boxes in fewer categories than seven and their ranks are adjusted to fit the rest of the informants ranking. Informants with adjusted rank-values are marked with \*. Adjusted and comparable ranks are written in italics.

Box	Contents %			Short description	Order of ranking by informants										
	Lichens	Dwarf shrubs	Plant litter		A1	A2*	A5*	A6	A7	B2*	B9	B10*	C1*	Sum	Rank
L74	74	0	8	18	<i>Cladonia</i>	1	1	1	1	1	1	1	1	1	1
					Lichen high approx. 5 cm	<i>1</i>	<i>1.5</i>	<i>1</i>	<i>9.5</i>						
L64	64	0	2	32	<i>Cladonia</i> and <i>Cetraria</i>	2	1	2	3	2	2	4	2	2	2
					Lichen high approx. 1 cm	2	<i>1.5</i>	2	3	2	3	4	2.5	2.5	22.5
L57	57	0	20	23	<i>Cladonia</i> , <i>Nephroma arcticum</i> , <i>Hylocomium</i> , <i>Dicranum</i> and <i>Polytrichum</i>	4	2	3	4	4	2	2	2	2	2
						4	<i>3.5</i>	3	4	4	3	2	2.5	2.5	28.5
L34	34	14	11	38	<i>Cladonia</i> , <i>Cetraria nivalis</i> , <i>Stereocaulon</i> , <i>Vaccinium vitis-idaea</i> , ( <i>Calluna vulgaris</i> ) and <i>Polytrichum</i>	3	2	4	2	3	2	3	3	3	3
						3	<i>3.5</i>	4	2	3	3	3	4	4	29.5
L33	33	21	25	20	<i>Cladonia</i> , <i>Empetrum</i> , ( <i>Vaccinium myrtillus</i> ) and <i>Hylocomium</i>	6	3	no	6	6	3	5	4	5	6
						6	6	6.5	6	6	6	5	5.5	6.5	53.5
L28	28	41	0	31	<i>Cladonia</i> , ( <i>Stereocaulon</i> ), ( <i>Cetraria</i> ), <i>Empetrum</i> and <i>Vaccinium myrtillus</i>	5	3	5	5	5	3	6	4	4	5
						5	6	5	5	5	6	6	5.5	5	48.5
L13	13	26	22	39	<i>Cladonia</i> , <i>Vaccinium vitis-idaea</i> , and <i>Dicranum</i>	7	3	no	7	7	3	7	no	5	7
						7	6	6.5	7	7	6	7	7	6.5	60

**Table 2.** Sami names of common lichens on different substrates used by 15 reindeer herders in northern Sweden based on interviews. Some herders did not answer or used a Swedish name while others used more than one name for the same species. The spelling for the Sami names generally follow Svonní (1990), but two names (marked \* and \*\*) are spelled according to Kåven *et al.* (1995) and Spiik (1994), respectively.

Lichen species on different substrates	Lahppu	Gatna	Soahki-gatna	Soahki-jeagil	Geadgi-jeagil	Geadgi-gatna	Jeagil	Visste **	Boazu-jeagil	Ránis-jeagil	Guhkká-jeagil*	Ullu-jeagil	Guohpa-jeagil
<b>Tree</b>													
<i>Bryoria</i> , <i>Alectoria</i> spp.	11												
<i>Hypogymnia</i> spp. & <i>Parmelia olivacea</i>		9	1	1									
<b>Stone</b>					9		1	1					
<i>Parmelia centrifuga</i> & <i>P. saxatilis</i>													
<i>Rhizocarpon</i>		2				3							
<b>Ground</b>							10	3	1	1			
<i>Cladonia arbuscula</i> & <i>Cl. rangiferina</i>							4	3			4	2	
<i>Cl. stellaris</i>							1						9
<i>Stereocaulon pascale</i>													

lichens of the genera *Cladonia*, *Cetraria*, *Nephroma* and/or *Stereocaulon* mixed with different mosses and dwarf shrubs (Table 1).

The informants were not given any information about the amount or species of plants in the different boxes. Four of the nine informants ranked the boxes into seven different categories; the other five grouped the boxes into fewer categories. To make the individual rankings comparable, the sum of the order of preference (1+2...+7) was adjusted to be equal for all informants, i.e. 28 (Table 1). 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 (Fig. 2): (A) from a forest dominated by *P. sylvestris*, with trees of different ages, and (B) from a forest of *P. sylvestris* with mainly large trees in a slightly rolling terrain and with boulders covered with lichens. 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 plant nomenclature follows Moberg & Holmåsén (1990) and Santesson *et al.* (2004) for lichens, and Hallingbäck & Holmåsén (1984) for mosses. Other plants are named according to Lid (1985).

The Sami names are underlined and follow the spelling of the North-Sami language, unless indicated otherwise. When the Lule-Sami word is identical to the North-Sami word, but with a slightly different pronunciation, only the North-Sami word is used. The spelling for the Sami names follows Svonní (1990), and in some cases Kåven *et al.* (1995) for North-Sami (SN) as well as Spiik (1994) for Lule-Sami (SL).

## Results

### *Sami names for lichens and mushrooms*

Ground lichens of the *Cladonia* genus were called jeagil (SN) or variations thereof, or visste (SL) (Table 2). Six of the informants have used guhkkajeagil (Kåven *et al.*, 1995) or ullujeagil for *Cl. stellaris*, and nine were able to distinguish *S. pascale* from *Cladonia* spp. and agreed on guophajeagil for *S. pascale*. Pendent lichens on trees (e.g. *Bryoria* and *Alectoria*) were named lahppu by 11 informants and foliose lichens epiphytic on trees (e.g. *Hypogymnia* and *Parmelia*) were called gatna by nine informants. The name gatna was also used for crustose lichens on rocks, especially *Rhizocarpon*, while the foliose *Parmelia* on rocks was called geadgijeagil (in English: rock- or stone-lichen) (Table 2).

For mushrooms, the informants only used the name guoppar for all species.

#### *Seasonal use of lichens and mushrooms*

All 17 informants participating in interviews I–III agreed upon lichens being grazed mainly during the wintertime (Oct.–Apr./May). According to seven out of eight informants from the mountain villages, reindeer feed on lichens even as late as May; this was also claimed by two out of five informants from the forest village (Fig. 3a). Feeding on lichens was said to occur to a lesser extent during the summer (Jun.–Aug.), but occurs if the weather was cold and humid when lichens are soft and moist. It was claimed that reindeer did not feed on dry lichens. All informants



Fig. 2. A. Mixed-aged pine forest (*Pinus sylvestris*) on (plain) flat ground.

B. *Pinus sylvestris* forest with mainly large trees in a slightly rolling terrain and with boulders covered by lichens

reported that reindeer began to regularly feed on lichens when the snow covered the ground.

Eleven out of 14 informants agreed that reindeer feed on mushrooms during the late summer (end of Jul./beginning of Aug. throughout Sep.) (Fig. 3b). Sixteen informants (interviews I–III) reported that reindeer are very fond of mushrooms, but during June and July the reindeer were considered to be fairly uninterested in mushrooms. The informants also reported that reindeer become harder to handle and gather into corrals in September if mushrooms were abundant. Six informants stressed that reindeer eat mushrooms in early winter as well (Oct.–Dec.), even under the snow (Figs. 3b–c), especially when the temperature is around freezing (0 °C). Five of the informants used the name guopparmátta or guopparruhtas (in English: mushroom “feet” or “roots”) for the old, black, frozen mushrooms under the snow (Fig. 3c).

#### *Preferred lichens and mushrooms*

Two informants expressed the opinion that reindeer can live without lichens, but one of them added that reindeer would then have to be given extra feed. Another informant thought that lichens are so nutritious that reindeer do not need much of it (referring to the epiphytic lichens, i.e. *Parmelia* spp., especially in the mountains).

All the 10 informants out of 14, who ranked the ground-living lichens (interviews I–III), considered fruticose lichens of the *Cladonia* genus as the first choice of the reindeer (Table 3). *S. pascale* is the last choice of reindeer according to five out of eight informants. The foliose lichen *N. arcticum* was chosen last according to two informants, one didn't know and 11 did not give any information (Table 3). One informant stressed that tree-living *Bryoria/Alectoria* spp. (lahppu) are preferred to ground-living lichens. Table 4 gives further comments from nine informants about lichens (interviews IV–V), when ranking the boxes. Five out of seven informants said that reindeer do not eat *N. arcticum*, and furthermore three out of four informants said that *S. pascale* is eaten only if the need arises (Table 4).

The informants had no knowledge about the different mushroom species.

#### *Characteristics of good winter grazing grounds*

In their ranking of the plant community boxes, the informants mainly considered the amount of lichens, but also the composition of lichen species. Two out of the nine informants classified the communities according to presumed gradients of soil moisture and snow. During the discussions most time was devoted to the snow conditions.

Because some of the informants could not rank the boxes according to a scale from 1 to 7, some values had to be adjusted before statistical analysis (Table 1). If only the four informants whose order of preference did not have to be adjusted are tested, Kendall's coefficient of concordance ( $W$ ) became 0.9285, and with all nine informants in the test included (after adjustments of the value as noted above),  $W=0.8805$ . In both cases the concordance is statistically significant at the 0.01 level. The test thus shows a high agreement between the informants ranking of the seven plant communities.

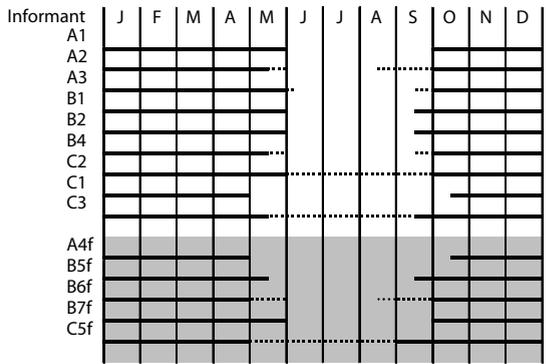
According to the nine informants, the best winter pasture is made up of the plant community box L74 with highest lichen (L) coverage (74%) and 5 cm-high lichens consisting mainly of *Cladonia* (Table 1). One informant considered that L74 was from a moist habitat and thus appropriate feeding grounds in the early winter (Oct.–Jan.), when the snow is not too deep. One informant argued that L74 was typical for (collected in) a forest with spruce (*Picea abies*) and birch (*B. pubescens*). The informants placed L64, containing about 1 cm-high lichens of mainly *Cladonia* spp. and covering 64%, as the second in rank. One informant argued that L64 represented a better grazing ground than L74, since it likely is drier and has better snow conditions. One informant thus thought that L64 could provide good grazing in the late winter (Jan.–Mar.). Another informant considered L64 to be over-grazed so it should not be used for two or three years, and thus the informant placed that box in the fourth place.

One informant thought that plant communities L64, L54 and L34 were comparable as pastures, but that L54 was the poorest in nutrients. Box L54 contained *Cladonia* spp. and *N. arcticum* in about equal proportions covering 54% of the box area (Table 1).

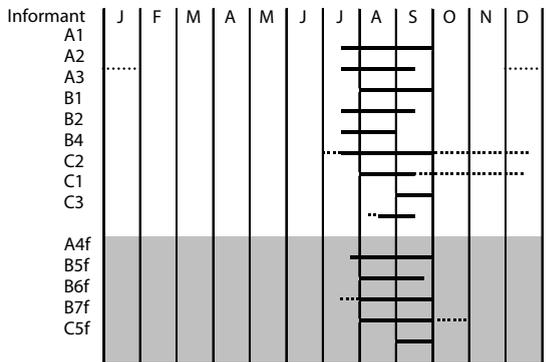
The last three boxes, L28, L33 and L13 with *Cladonia* and the dwarf shrubs *Empetrum* sp., *Vaccinium vitis-idaea* and *V. myrtillos* and mosses in various proportions (Table 1). All informants placed the shrub-dominated boxes last. Two informants also classified the three lowest-ranking boxes according to how they, as herders, prefer to use them as grazing land in the early or in the late winter. They prefer to use L13 and L33 in the early winter (Oct.–Jan.) and L28 in the late winter (Jan.–Mar.).

The plant communities, which the informants said were suitable for grazing in the early winter, were moist areas with mosses (here represented by L74, L57, L33 and L13). Plant communities considered appropriate for late winter feeding, should be on drier ground (represented by L64, L34 and L28). None of the other informants had a different opinion than those reported here.

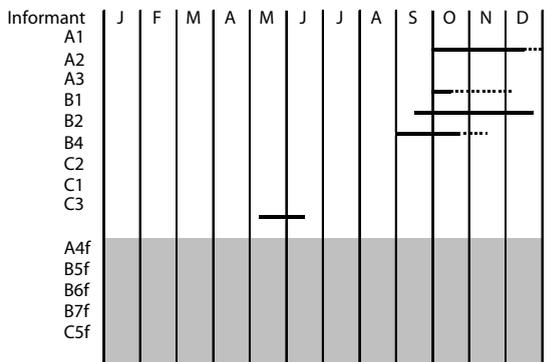
### a) Lichens



### b) Mushrooms (Guoppar)



### c) Mushrooms (frozen, under snow)



- Regularly grazed
- ..... Occasionally grazed or when available
- Mountain reindeer herding district
- Forest reindeer herding district

Fig. 3a-c. Seasonal use of lichens and mushrooms by semi-domesticated reindeer. Are based on interviews with 14 out of 17 reindeer herders in northern Sweden. Each horizontal line represents one informant (informants B3, B8f and C4 are not included).

Further comments on the plant community boxes are given in Table 4. Seven informants were convinced that reindeer eat *Empetrum* sp. and *Vaccinium myrtillus*, and three informants said that reindeer graze upon *V. vitis-idaea*. *Empetrum* is grazed especially in the mountain areas and in the early spring.

#### Factors of importance in winter grazing areas

During the second experiment (comparison of the two photos, Fig. 2), the following habitat characteristics were regarded as important for the value of winter grazing areas.

Small *P. sylvestris* or young forests indicate inferior conditions due to more snow and low lichen growth due to shading (Fig. 2A). An occurrence of large *P. sylvestris* trees indicates low snow depth and more light so that the lichens can grow better (Fig. 2B). In old *P. sylvestris* forests with large trees, the snow conditions are better for the reindeer during the whole winter. Good snow conditions means < 50 cm and soft snow which is easy to dig. *P. sylvestris* forests represent better winter grazing areas than *P. abies*

forests. If such forests are located at a higher altitude they are used during October to January, because thereafter the snow is deeper and sometimes harder.

In a rolling terrain, the snow was considered easier to dig and, according to two informants, there are also more lichens (Fig. 2B). This is explained by more open and better light conditions due to larger *P. sylvestris*. Further, such rolling areas are likely less grazed than flatter ones. According to two informants, reindeer prefer to graze on flat ground (Fig. 2A). It can be easier to dig out lichens in the flat areas in early spring when the snow becomes coarse-grained, because in late winter the snow is often harder (Fig. 2A).

## Discussion

People's collective knowledge about their environment is based upon the phenomenon that things have a known terminology in the collective. And if we can agree on this, the traditional ecological knowledge about reindeer feeding on lichens can be said to begin

**Table 3.** Preferences of semi-domesticated reindeer in northern Sweden for ground living lichens indicated by 14 interviewed reindeer herders. See also Table 4 for comments on the lichen species and their use by reindeer.

	First	Sometimes	Last	Never	Don't know	No information
Species						
<i>Cladonia rangiferina</i> and <i>Cl. arbuscula</i>	10	0	0	0	0	4
<i>Cl. stellaris</i>	10	0	0	0	0	4
<i>Stereocaulon pascale</i>	1	2	5	0	0	6
<i>Nephroma arcticum</i>	0	0	2	0	1	11

**Table 4.** Preference of semi-domesticated reindeer for ground-living lichens and dwarf shrubs as indicated by nine reindeer herders in northern Sweden when ranking the seven plant community boxes (see Table 1). The seasons are: wi=winter (Oct.-Mar.), sp=spring (Apr.-May) and su=summer (Jun.-Aug.). See also Table 3 for comments on ground-living lichens and their use by reindeer.

Species	Grazed by reindeer					Season when grazed
	Yes	If need arises	No	Uncertain		
				yes	no	
<i>Cetraria islandica</i>	1		1			
<i>Ce. nivalis</i>	3					
<i>Cladonia pyxidata</i>	4	1				
<i>Empetrum</i> spp.	7					wi, sp, wi-sp
<i>Nephroma arcticum</i>	2	1	2		2	
<i>Stereocaulon</i> spp.	1	3				
<i>Vaccinium myrtillus</i>	7			1		wi, su
<i>V. vitis-idaea</i>	3	1		2	2	wi

when the herders have named the lichens. With a terminology, things become more distinct and can then more easily be passed on to the next generation (e.g. Berlin, 1992; Berkes, 1999; Wenzel, 1999).

The Sami names for the lichens found in my study were not always in accordance with the names given in Wahrenberg *et al.* (1997). The explanation is probably that some of the names used there were a literal translation from Swedish to Sami, but also because popular names of plants normally differ from one place to another.

Among the reindeer herders, the terminology of lichens was clear concerning habitat and appearance (Nissen, 1921; pers. comm. T. Partapuoli, 1998): jeagil (SN) or visste (SL) for fruticose lichens on the ground, lahppu for tree-living pendent lichens, and gatna for foliose lichens on trees. The word gatna was also used for crustosed lichens, such as *Rhizocarpon*, on rocks. The word gatna relates to the fact that only small pieces of the lichen can be eaten at a time (Nielsen, 1979 v. II p. 12). The term ganastit (compare gatna) means that the reindeer feed on lichens from trees and that was irrespective of it being lahppu, *Bryoria/Alectoria* or gatna, *Hypogymnia/Parmelia* (pers. comm. B. Saitton, 2002). Two of the informants used the term ganastit in similar circumstances.

In my study, the reindeer herders state that reindeer prefer *Cl. rangiferina*, *Cl. arbuscula* and *Cl. stellaris*, a pattern which is confirmed by earlier research (e.g. Nissen, 1921; Hustich, 1951; Holleman & Luick, 1977; Skjenneberg & Slagsvold, 1979 [1968]; Danell *et al.*, 1994). From the literature we know that reindeer feed on tree-growing lichens such as *Bryoria*, *Parmelia* and *Hypogymnia* spp. (Skjenneberg & Slagsvold, 1979 [1968]; Helle & Tarvainen, 1984). Tree-living lichens like *Bryoria/Alectoria* were said to be preferred to ground-living lichens by one informant. Another informant said that epiphytic lichens such as *Parmelia* were more nutritious than ground-living lichens and because of that the reindeer did not need that much of them. According to the literature, species of *Bryoria/Alectoria* had a higher level of protein than ground-living lichens like *Cladonia* species (Nieminen, 1994; Storeheier *et al.*, 2002a).

The fact that reindeer follow an intrinsic rhythm with differences in appetite throughout the year with a catabolic phase in the winter and an anabolic phase in the summer (McEwan & Whitehead, 1970; Tyler & Blix, 1990) may explain why some informants thought that some lichens were so nutritious that reindeer did not need so much of them. The annual changes imply lower or even no body growth during the winter months (McEwan & Whitehead, 1970).

The reindeer herders have stated that there are also lichen genera, such as *Stereocaulon* and *Nephroma* that

the reindeer avoid, or graze only if they have to. Both species contain both green algae and nitrogen-fixing cyanobacteria (Kallio *et al.*, 1972; Millbank, 1976; Storeheier *et al.*, 2002a) and may have more energy to allow them to produce secondary compounds of allelochemical character (Mattson, 1980), which may cause avoidance (White & Trudell, 1980). It is interesting to note that *Stereocaulon* contain more nutrition than *Cladonia* species. Observations confirm that reindeer do not consume *Stereocaulon* if other lichen are available (Lönnerberg, 1909; Holleman & Luick, 1977; Danell *et al.* 1994). The reason why reindeer seemingly prefer less nutritious forage might be that the microbes in their digestive system have adapted to a thin diet during the winter (Storeheier *et al.*, 2002a).

The knowledge of mushrooms that reindeer feed upon was limited to observing that reindeer eat them and are very fond of them. None of the informants had any other name than guoppar, which seemed to be the only Sami name for mushrooms. But according to M. Svonni (pers. comm., 2002), mushrooms were previously called visste in the North-Sami area, but today guoppar is used. Today the word visitit (SN) is used (compare with visste) meaning that “the reindeer goes after mushrooms” or “the reindeer goes after something it likes”, and earlier also “the reindeer goes after a mountain lemming, *Lemmus lemmus*” (Nielsen, 1979 v. III p. 777). It is obvious that reindeer are very fond of mushrooms and this is supported by the term visitit. As a curiosity, Linnaeus (Carl von Linné) was told by the Sami that reindeer occasionally eat lemmings (Linnaeus, 2003 [1732]). My informants did not use mushrooms in their personal diet. In earlier days, mushrooms were not considered suitable for human consumption in the countryside in Scandinavia (Norway and Sweden) and the Sami were generally suspicious of mushrooms (Eidlitz, 1969). This is probably one of the explanations for the poor knowledge of mushrooms in this studied area. On the other hand, mushrooms are commonly eaten by the Sami in Finland and Russia (Volkov, 1996 [1946]).

Roughly it seems that reindeer herders emphasize the value of lichens in the winter grazing area. The availability of lichen is important but is not the only determinant whether the pastureland is good or bad. They also pay attention to whether the ground is moist or dry, the snow conditions and the type of forest. The most important question is if lichens are available under the snow cover (Ruong, 1964; Ryd, 2001). According to my own experience, the most common phrase used out of politeness when herders from different areas meet is: “Do the reindeer graze?” And if the reindeer don’t graze, lichens or other forage are probably not available due to the snow cover. Snow is the most important factor that determines if

a winter grazing area is good or bad (e.g. Pruitt, 1959; Helle, 1984). In the Sami language there are a number of terms for snow relating to the reindeer's search for food and about the snow conditions for moving by animals and people (Ruong, 1964; Jernsletten, 1997; Ryd, 2001), and those terms make it clear that snow is an important constraint for the well-being of reindeer during the winter (e.g. Pruitt, 1959; Skogland, 1978; Helle, 1984; Collins & Smith, 1991). When the snow becomes hard during early spring (Mar./Apr.), the reindeer switch to feeding on tree-growing lichens (e.g. Skjenneberg & Slagsvold, 1979 [1968]; Helle & Tarvainen, 1984), but if such lichens are scarce or missing, today the herders have the ability to feed them with emergency fodder such as reindeer pellets, or with hay and lichens harvested or bought by the herders.

The reindeer herders had both an interest in and an opinion on the problems of the winter grazing period. An important part of the informants' assessment of winter grazing grounds was the timing of its use. A good area during one part of the winter could be impossible to use during another period, regardless of the amount of lichens there. Thus the reindeer herders choose winter lands by herding the reindeer to feed efficiently. In the early winter the reindeer can feed almost anywhere as long as there is something edible and the amount of snow and consistency are normal for that time of year. It is without exception the expected condition of the snow that was the most important factor when the reindeer herders evaluated the grazing ground.

In the beginning of the 20<sup>th</sup> century, when reindeer herding involved in general more close contact with the reindeer, the Sami reindeer herders had a more detailed nomenclature for lichen than today (Qvigstad, 1901; Nielsen, 1912; Nissen, 1921). In today's extensive reindeer herding, with very few completely domesticated animals and less contact with the herd as well as the ever increasing use of motorized vehicles, younger reindeer herders in general possess a less detailed knowledge of the plants grazed by the reindeer (Helander, 1992). The reindeer herding Sami in northern Sweden use a nomenclature for lichen that is optimized for use in their everyday work, that means, lichen are categorized by their habitat and appearance. The reindeer herders can effectively communicate the properties of a certain area, such as the species of trees growing there and the humidity of the ground, by simply mentioning what species of lichen grow there.

Today the grazing areas are used and exploited by other land users and probably this situation will force the reindeer herders in the time to come to place greater importance in botanical knowledge. My investigation

indicates that reindeer herders in the age group under study have a functional view of which lichens reindeer graze and also have a concomitant nomenclature to be used during work. I think that in the future, the reindeer herders should widen their knowledge about the names of plants (including the scientific names) to assert themselves in different conflicts about land use.

## Acknowledgements

Sincere thanks to all the informants for kindly and patiently sharing their time and knowledge with me during many hours. I also value the thoughts around the Sami terminology that Mikael Svonni, Bror Saitton and Thomas Partapuoli shared with me. Constructive comments on this and earlier versions of the manuscript by Kjell Danell, Öje Danell and Roger Bergström are appreciated. Two anonymous referees are also acknowledged. The study was financially supported by Mountain-Mistra programme phase I (grants to Öje Danell), the Sami fund and EU-Goal 6.

### *Informants/interviewees*

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Leavas Sami village: Erik Huvva, Krokvik; Erik Poidnakk, Ahkkarjokk; Nikolaus Stenberg, Årosjokk; Petter Poidnakk, Ahkkarjokk; Rangvald Pingi, Krokvik; Rolf Inga, Krokvik; Sixten Svonni, Rautas and chairman Roger Blind, Nikkaluokta.

Girjas Sami village: Enok Blind, Gällivare; Sara Rikko, Kaitum and chairman Ingemar Blind, Kiruna.

Udtja Sami village: Alf Teilus, Kåbdalis; E. Georg Mikaelsson, Vidsel; Elsa Teilus, Kåbdalis; John Stokke, Tellejokk; Nils-Henrik Teilus, Kåbdalis; Sven Edman, Harads and chairman Rune Stokke, Kåbdalis.

Other informants: Johan Rassa, Jokkmokk; Margareta and Nikolaus Stenberg, Årosjokk; Tor-Erik Huvva, Holmajärvi, Sweden.

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*Manuscript received 13 March, 2007*  
*revision accepted 18 October, 2007*

Renens (*Rangifer tarandus tarandus*) bete av lavar och svampar: Traditionell ekologisk kunskap bland renskötande samer i norra Sverige

*Abstract in Swedish / Sammanfattning:* Studien genomfördes i fyra renskötseldistrikt (samebyar) i norra Sverige. Totalt 22 renskötande samer, födda 1950 eller tidigare, blev intervjuade om renens betande av lavar och svampar, renens vinterbete och om vad som karaktäriserar ett bra vinterbetesland. Informanterna hävdade att lavar företrädesvis betas under vintern, men även kan betas under sommaren då vädret är kallt och fuktigt. Svampar betas under höstmånaderna augusti och september, men enligt några informanter kan svamp även betas senare på hösten (från oktober) när den är frusen och under snön. Renskötarna har namn på lavar som i generella termer beskriver deras utseende och växtplats. För svampar använder de enbart ett samiskt namn, guoppar. Av de marklevande lavarna ansåg informanterna att renarna föredrar *Cladonia*-arter (renlavar), medan kväve-fixerade arter som *Nephroma arcticum* (norrlandslav) och *Stereocaulon pascale* (påskrislav) inte ansågs föredras av renarna. Snöförhållandena är mycket viktiga, och ju mindre snö (och ju lösare den är) desto bättre. Växtplatser där renskötarna vet av erfarenhet att snöförhållandena kan bli problematiska, t.ex. i fuktiga och öppna områden med små träd, används till bete tidigt under vintern (oktober-januari) innan för mycket snö har fallit. Ett bra vinterbetesområde ska ha gott om lavar. Det bästa är en torr tallhed (*Pinus sylvestris*) med stora och gamla träd med vida kronor som fångar upp snön som upplega och på det viset skyddar marken från snö, vilket gör det lättare för renarna att gräva.

**Appendix.** Background information about 22 Sami reindeer herders in northern Sweden interviewed during the time period 1999-2002. The capital letter in the informant code indicates age-groups (A=50-64, B=65-79 and C=80-94). An “f” at the end means forest reindeer herding district, while the other informants came from mountain reindeer herding districts. Age refers to the first interview occasion the informant participated in. Civil status is: m=married, um=unmarried and ch=children and sex: M=male and F=female. Many of the informants started as active reindeer herders after elementary school, when they were 13-15 years old, and as adults they had their own reindeer herding firm. The females in this study did not have their own firms, but participated in their family reindeer herding firm. Education courses include all education, even short courses (mostly in economics), in which the informants had participated after elementary school. A + between interview numbers (see text) means that they were done during the same day.

Code	Information about the informants				Participation in interview			
	Age	Sex	Civil state	Active as reindeer herders, years	Education, courses	Speaks Sámi	Number of interviews	Interviewed alone
A1	53	M	m, ch	1960 – 1966	yes	yes	I + II, III, IV, V	III
A2	57	M	m, ch	1955 –	yes	yes	I, II, III, IV, V	III
A3	64	M	m, ch	1950 –	no	yes	I, II, III	III
A4f	60	M	unm	1959 –	no	yes	I, II, III	I, II, III
A5	57	M	m, ch	1972 –	yes	yes	IV, V	
A6	57	M	m, ch	1982 –	yes	yes	IV + V	
A7	59	M	unm	1970 –	yes	yes	V	
B1	66	M	unm	1977 – 1994	yes	yes	I, II, III	I, II, III
B2	70	M	unm	1944 – 1980	no	yes	I, II, III, IV, V	I, II, III
B3	71	F	m, ch	yes, with family	yes	yes	I, III	I, III
B4	73	M	unm	1940 –	yes	yes	I, II, III	I, II, III
B5f	68	M	m, ch	1946 –	no	no	I, II, III	I, II, III
B6f	68	M	m, ch	1945 – 1995	no	no	I + II, III	III
B7f	76	M	unm	1932 –	no	yes	I, II, III	III
B8f	78	F	unm	yes, with family	yes	yes	I, II, III	III
B9	72	M	m, ch	1943 –	yes	yes	IV, V	IV, V
B10	72	M	m, ch	1942 –	no	yes	IV, V	V
C1	80	M	m, ch	1951 – 1997	yes	yes	I, II, III, IV, V	I, II, III
C2	80	M	unm	1933 – 45, 1960 – 79	no	yes	I, II, III	I, II, III
C3	86	M	m, ch	1926 – 1982	no	yes	I, II, III	III
C4	90	M	unm	1923 – 1976	no	yes	I	I
C5f	83	M	m, ch	1926 – 45, 1965 – 94	no	no	I, II, III	III