

Traditional ecological knowledge among Sami reindeer herders in northern Sweden about vascular plants grazed by reindeer

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Abstract. Traditional knowledge about how reindeer utilize forage resources was expected to be crucial to reindeer herders. Seventeen Sami reindeer herders in four reindeer herding communities in Sweden (“samebyar” in Swedish) were interviewed about plants species considered to be important reindeer food plants in scientific literature. Among 40 plant species, which the informants were asked to identify and indicate whether and when they were grazed by reindeer, they identified a total of 21 plant taxa and five plant groups. They especially recognised species that were used as human food by the Sami themselves, but certain specific forage plants were also identified. Detailed knowledge of vascular plants at the species level was surprisingly general, which may indicate that knowledge of pasture resources in a detailed species level is not of vital importance. This fact is in sharp contradiction to the detailed knowledge that Sami people express for example about reindeer (as an animal) or snow (as physical element). The plausible explanation is that observations of individual plant species are unnecessarily detailed information in large-scale reindeer pastoralism, because the animals graze freely under loose herding and border surveillance.

Key words: forage; pastoralism; range management; reindeer husbandry; reindeer pasture; Sami reindeer herders; scientific knowledge; Sweden; TEK; traditional knowledge; vascular plants; vegetation.

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Introduction

Like other traditional subsistence uses of natural resources, reindeer husbandry is partly based on a body of traditional ecological knowledge (TEK). TEK often tends to be perceived as qualitative and categorical in character and with significant detailed knowledge of central phenomena or occurrences (e.g. Berlin, 1992; Berkes, 1999; Berkes *et al.*, 2000; Usher, 2000), such as snow conditions and characteristics of animals in the context of reindeer husbandry. Phenomena that have not been important for human survival are described in significantly less details. The richness of details is often tied to the culture-bearing language

used in the daily work, in this case Sami which is known for its extensive terminology for describing many natural phenomena (e.g., Ruong, 1964, 1968; Collinder, 1984; Eythorsson, 1993; Jernsletten, 1997; Ryd, 2001; Helander-Renvall, 2007).

Because of their long interaction with reindeer, the Sami undoubtedly have an intimate knowledge about reindeer as animals and their behaviour and movements in the landscape at different spatial scales (e.g. Aronsson, 1991; Storli, 1993). It could be hypothesized that the change from hunting to intensive reindeer pastoralism 4-5 centuries ago (Paine, 1994) may have altered the focus from animals towards



Fig. 1. Summer grazing areas of the four Sami reindeer herding communities included in the study. The map is based on information from Renbeteskommissionen, svensk - norska (2001), Kempainen *et al.* (1997). Drawing: Jon Mihkkal Inga.

the resources used by reindeer for their well-being. This change may have generated knowledge about forage plants as a substantial part of the TEK. If so, however, the fairly recent (during less than a century) transition to more extensive herding may have weakened it. Sami nomenclature for flora is documented from the late 1800s and early 1900s; e.g. published works by Qvigstad (1901) containing Sami names of plants.

The Sami people in Scandinavia and their use of land and water have mostly been studied in terms of anthropology or ethnology (e.g. Manker, 1953; Ruong, 1956, 1967; Ingold,

1978; Beach, 1981; Paine, 1994). During the 18th century, the naturalist Carl Linneaus travelled in the north of Sweden and collected information from the Sami, e.g. on vegetables they used in their own fare and also on what reindeer grazed upon (Linneaus, 2003 (1732)). In the beginning of the 20th century compilations of knowledge about reindeer food plants were to a large extent based on experiences gathered from reindeer herders (Lönnberg, 1909; Holmboe, 1912). During 1947–57 Skuncke (1958, 1969) made extensive field studies, where he identified food plants by examination of bite marks from grazing and analyses

Table 1. Background information about the interviewed reindeer herders.

Code	Age	Sex	Civil state	Active reindeer herders, years	Educa- tion	Speaks Sami	Number of inter- views	Inter- view alone
A1	53	M	m, ch	1960 – 1966	yes	yes	1+2, 3	3
A2	57	M	m, ch	1955 –	yes	yes	1, 2, 3	3
A3	64	M	m, ch	1950 –	no	yes	1, 2, 3	3
A4f	60	M	unm	1959 –	no	yes	1, 2, 3	1, 2, 3
B1	66	M	unm	1977 – 1994	yes	yes	1, 2, 3	1, 2, 3
B2	70	M	unm	1944 – 1980	no	yes	1, 2, 3	1, 2, 3
B3	71	F	m, ch	yes, with family	yes	yes	1, 3	1, 3
B4	73	M	unm	1940 –	yes	yes	1, 2, 3	1, 2, 3
B5f	68	M	m, ch	1946 –	no	no	1, 2, 3	1, 2, 3
B6f	68	M	m, ch	1945 – 1995	no	no	1+2, 3	3
B7f	76	M	unm	1932 –	no	yes	1, 2, 3	3
B8f	78	F	unm	yes, with family	yes	yes	1, 2, 3	3
C1	80	M	m, ch	1951 – 1997	yes	yes	1, 2, 3	1, 2, 3
C2	80	M	unm	1933 – 45, 1960 – 79	no	yes	1, 2, 3	1, 2, 3
C3	86	M	m, ch	1926 – 1982	no	yes	1, 2, 3	3
C4	90	M	unm	1923 – 1976	no	yes	1	1
C5f	83	M	m, ch	1926 – 45, 1965 – 94	no	no	1, 2, 3	3

The capital letter in the informant codes indicates the age-group they belonged to when the first interview was done (A=50–64 years, B=65–79 years and C=80–94 years). An “f” at the end of the code indicates that the informant belongs to the forest reindeer-herding community. Gender is indicated by M for man and F for woman. Civil status is coded by m=married, um=unmarried and ch=having children. Education include all education and even short courses, which the informants have participated in after the elementary school. During interview 1 the informants identified and classified different species, interview 2 was about when different plant taxa or species were grazed by reindeer during the year and interview 3 was a complementary interview.

of rumen contents. According to Skuncke the results were verified through discussions with about 100 skilled reindeer herders, without telling them about his own observations.

A deeper insight in the traditional knowledge concerning individual plant species used by reindeer is valuable in the development of formal management systems for reindeer pastures. The purpose of this investigation was to explore the extent of current traditional knowledge among Sami reindeer herders on the vascular plants that are considered to be important forage plants for reindeer in the scientific literature. Particular questions were how well reindeer herders identify vascular plants and

to what degree the informants consider these plants to be used by reindeer. We also wanted to know if reindeer herders have any special taxonomy or terminology for plants, which differs from the scientific descriptions. The investigation refers to the conditions during the “summer” (i.e. the snow-free season) in four Sami reindeer herding communities (“sameby” in Swedish) in northern Sweden. This study includes the most common reindeer food plants but we excluded mushrooms and lichens. It is well documented that reindeer extensively use ground and arboreal lichens especially during seasons when vascular plant forage is scarce (e.g. Skjenneberg & Slagsvold, 1979). Lichens

are not regularly grazed during the summer, when green vascular plants are available.

Material and methods

The investigation was carried out in 1999 by interviewing a total of 17 informants in three mountain reindeer herding communities situated at 68°N (Gabna, Laevas and Girjas) and one forest reindeer herding community (Ud-tja) at 66°N (Fig. 1). The mountain reindeer herding communities practise migratory reindeer herding with spring (May–June), summer and autumn (Sept.–Nov./Dec.) grazing in the mountains and the nearby subalpine birch and boreal coniferous forests (altitudes approx. 400–1500 m a.s.l., birch timberline 450–750 m a.s.l.). The reindeer predominantly use the mountain ranges during the “summer”. Snow cover in the mountain area extends from mid-September to mid-June (Dahlström, 1995). Average temperatures in these areas during 1961–1990 were +9 °C in July and -11.5 °C in January (Vedin, 1995).

Winter grazing occurs in lichen-rich coniferous forests at lower altitudes. The reindeer herding in the forest reindeer herding community is more sedentary within boreal forest below 600 m a.s.l. all year around, although different parts of the landscape are used during the different seasons. Snow cover in the forest area extends from October to mid-May (Dahlström, 1995) and average temperatures during 1961–1990 were +11 °C in July and -15 °C in January (Vedin, 1995).

The four reindeer herding communities induced in the study had 370 members all together (i.e. reindeer owners), of which 204 persons were born in 1950 or earlier (O. Ekström, 1999, pers. comm.). Among these 204 members, the 17 informants for this investigation were selected with the help of the chairmen of each reindeer herding community (Table 1). The aim was to get a group of informants, who were experienced and self-suffi-

cient reindeer herders. The selected informants were considered trusted persons and could be expected to be those who currently were transmitting the professional herder knowledge to younger people. The criteria used, besides age, were that they were raised in reindeer-herding families and either still were or have been active reindeer herders. We intentionally chose older informants who have learned their profession during a period with more intense reindeer herding than today, and thereby have had closer and more frequent contacts with the herds than younger reindeer herders likely have had. Apart from this, it is fairly rare among this group of older herders to have received formal education in plant taxonomy or some other biological discipline. This makes it more likely to find informants with genuine traditional knowledge. Additional requirements were that they had not previously participated in a similar study regarding reindeer food plants and that they agreed to participate in the present investigation. Particular interest in plants *per se* was not requested.

Ten of the male informants started as reindeer herders when they were 13–15 years old after finishing primary school. Two informants said that they started when they were around ten years old. They had participated in most activities until advanced age caused them to slow down, although they still participated in e.g. the roundups and work in the corrals (Table 1). All the informants had their own reindeer-herding firm as adults, except for the two female informants who said that they were active in reindeer herding within the family firm. The females and two of the male informants had education (one year or more) beyond six or seven years in primary school.

The interviews were carried out by the first author in the informants' own homes, sometimes in the presence of family members. The informants could choose to answer in either the Sami or Swedish language. Among the 14

Table 2. Summary of responses about 29 plant taxa and 40 species presented to 17 informants as close-up pictures (photos and drawings) and two additional species introduced by the informants. The taxonomy follows Mossberg & Stenberg (2003). # is collective name or identification; ** means no picture was shown; underlined name means Sami name.

Plant taxa	Identification		Claimed use by reindeer		
	By name	No name	Grazed	Not grazed	Did not know
** # <i>Betula pubescens</i> spp.	16		16		
<i>Betula pubescens</i> ssp. <i>czerepanovii</i>	3				
<i>Betula nana</i>	16		16		
<i>Salix</i> spp.	17		17		
# <i>Salix glauca</i> , # <i>S. lapponum</i> , # <i>S. phylicifolia</i>					
** # <i>S. herbacea</i> or similar plant taxa	2		2		
<i>Empetrum nigrum</i> ssp. <i>hermaphroditum</i>	17		11	1	5
<i>Vaccinium myrtillus</i>	17		14	1	2
<i>Vaccinium uliginosum</i> ssp. <i>uliginosum</i>	12	5	8	2	7
** <i>Vaccinium vitis-idaea</i> ssp. <i>vitis-idaea</i>	17		9	3	4
<i>Angelica archangelica</i>	13		3	8	2
ssp. <i>archangelica</i>	11		11		
	3	1			2
<i>Bistorta viviparum</i>		1			
<i>Cicerbita alpina</i>	0				
<i>Cirsium helenioides</i>	0				
<i>Comarum palustre</i>		1	1		
<i>Epilobium angustifolium</i>	13	4	15		2
<i>Filipendula ulmaria</i>		1			
<i>Geranium sylvaticum</i>	0				
<i>Melampyrum sylvaticum</i>	1		1		
<i>Menyanthes trifoliata</i>	8	5	8	1	4
<i>Oxyria digyna</i>	8	6	10	1	2
<i>Potentilla erecta</i>	0				
<i>Rubus chamaemorus</i>	17		14	2	1
<i>Rumex acetosa</i> ssp. <i>acetosa</i>	16	1	15		2
<i>Solidago virgaurea</i> ssp. <i>virgaurea</i>	2	12	5	1	8
Grasses (<u>sitnu</u> in Sami)	17		17		
# <i>Deschampsia flexuosa</i> ssp. <i>flexuosa</i> ,					
# <i>D. alpina</i> , # <i>Festuca ovina</i> , # <i>Poa alpina</i>					
<i>Deschampsia cespitosa</i> ssp. <i>cespitosa</i>	0				
<i>Eriophorum angustifolium</i> ssp. <i>angustifolium</i>	0				
<i>Eriophorum scheuchzeri</i>	0				
<i>Eriophorum vaginatum</i>	16		13		2
<i>Equisetum fluviatile</i>	17		17		
<i>Equisetum hyemale</i>	1				
<i>Juncus trifidus</i>	0				
<i>Luzula pilosa</i>		1			
<i>Phleum alpinum</i>	0				
<i>Trichophorum cespitosum</i> ssp. <i>cespitosum</i>	0				
<i>Trichophorum alpinum</i>	0				
<i>Carex</i> spp.	15	2	14		3
# <i>Carex rostrata</i> , # <i>C. aquatilis</i> ssp. <i>aquatilis</i>					
<i>Carex bigelowii</i> ssp. <i>rigida</i>	0				

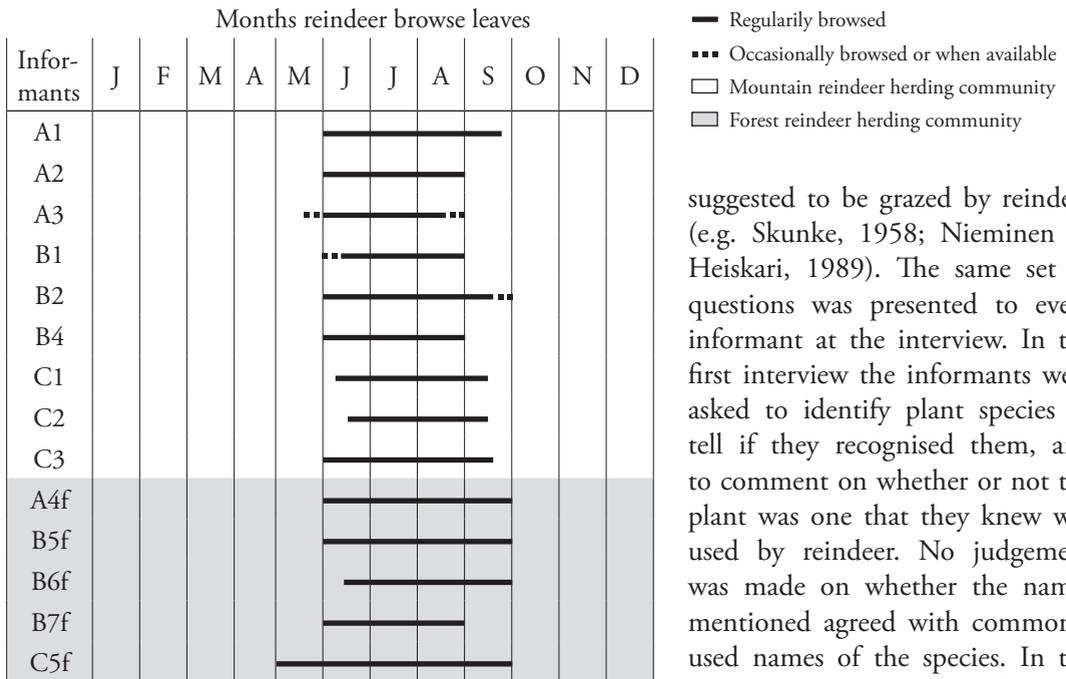


Fig. 2. Informant responses on questions when reindeer browse leaves from *Betula* spp. and *Salix* spp. The information was drawn by the informants on graphs representing one year. Information from informants B3, B8f and C4 are not included because they declared that they could not define when reindeer use different plants and/or did not participate in the second interview.

Sami-speaking informants, six chose to speak Swedish during all interviews. Informant B5f chose to be interviewed away from home, and informants B7f and B8f were interviewed together. Most of the informants were interviewed three times. Two of them were interviewed twice the same day (A1 and B6f).

At the interviews, the informants were shown close-up pictures (photos and drawings) of 40 individual plant species (Table 2) from a flora of important reindeer food plants (Warenberg *et al.*, 1997). The 40 plants shown to the informants belong to a selection of 60 plant species, generally considered to be among the most important for reindeer according to scientific knowledge about reindeer. These are a sample of the more than 250 plant species

suggested to be grazed by reindeer (e.g. Skunke, 1958; Nieminen & Heiskari, 1989). The same set of questions was presented to every informant at the interview. In the first interview the informants were asked to identify plant species or tell if they recognised them, and to comment on whether or not the plant was one that they knew was used by reindeer. No judgement was made on whether the names mentioned agreed with commonly used names of the species. In the second interview the informants were asked about what time of year reindeer graze the various plant taxa and some of the species that most of the informants classified as reindeer food plants (Table 2). On a figure representing the course of a year the informants were asked to draw

themselves or guide the interviewer to draw when they claimed the reindeer grazed the different species or groups (Figs. 2 and 3a-e). The third interview was done mostly by telephone with the sole purpose of completing the data that had already been collected. Exceptions were informants B2, C2 and C3, who were interviewed in their homes about the collected data. To avoid guesses, none of the informants were forced to answer every question. The questions were completed with follow-up questions depending on how the informants responded.

Interviews 1 and 2 were recorded on tape, except for the second interview with informant C1 where only notes were taken. The recorded materials were transcribed afterwards by persons who speak both Sami and Swedish and

Figs. 3a-e. Informants' responses to questions about when reindeer graze different species (one row for each informant). The information was drawn by the informants on a graph representing one year. Information from B3, B8f and C4 are not included because they declared that they could not define when reindeer use different plants and/or did not participate in the second interview. Parentheses indicate informants that did not answer this question.

- Regularly grazed
- Occasionally grazed or when available
- Mountain reindeer herding community
- Forest reindeer herding community

analysed using the NUD*IST software (Qualitative Solutions & Research Pty Ltd., 1997).

The scientific nomenclature of the plants followed Mossberg & Stenberg (2003). In the following the Sami names are underlined and follow the North Sami language (NS) spelling according to Svonni (1990). When the Lule Sami language (LS) name is different it follows the spelling by Korhonen (2006).

The answers concerning the informants' identifications 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" and "use not addressed by respondent", respectively.

Differences between reindeer herding communities in responses could be expected *a priori*. The associations of reindeer herding communities and responses were therefore tested

Fig. 3a Months reindeer graze dwarf shrubs

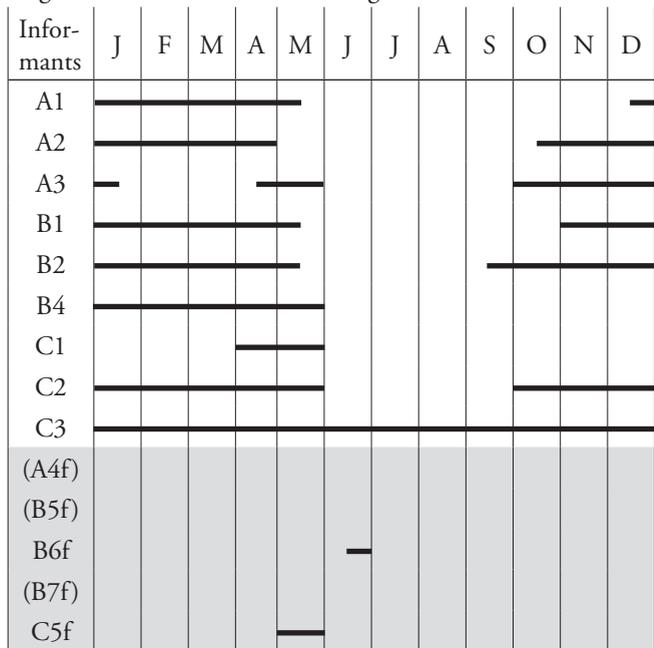
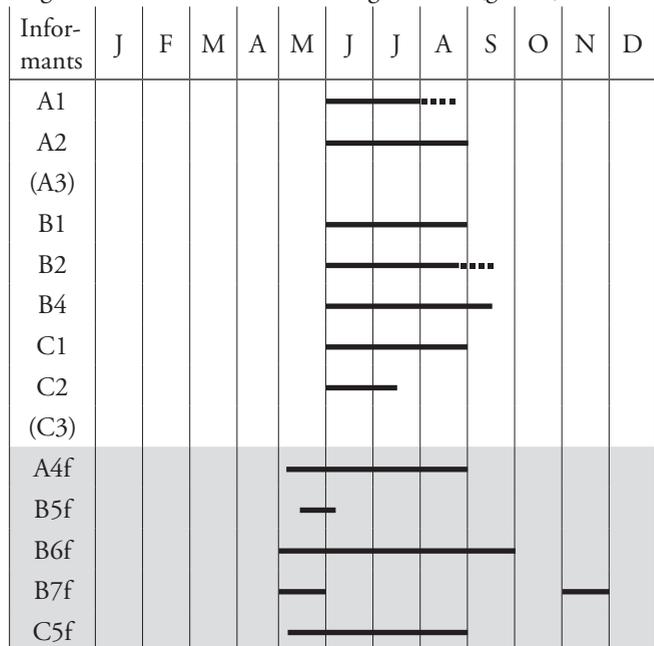
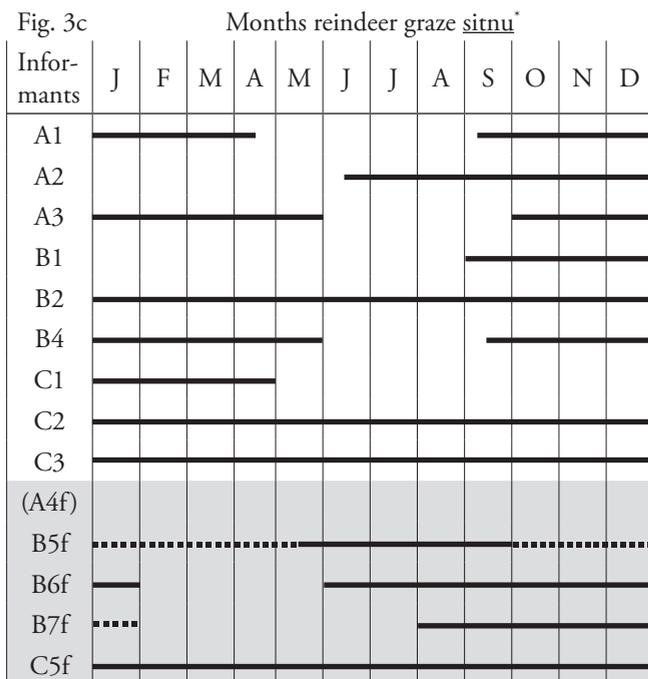


Fig. 3b Months reindeer graze rássi (grasses)



with Fisher's exact test in the FREQ procedure of the SAS statistical software (SAS Institute Inc., 2002) for all species merged, for groups of species, and for some specific species.



* Sitnu can be wintergreen and smooth grasses like *Deshampsia flexuosa* / *D. alpina* / *Festuca ovina* / *Poa alpina*.

Results

Identification of plants / plant groups

No significant associations ($P > 0.05$) were found between reindeer herding communities and responses, meaning that the responses were similar regardless of which reindeer herding community the informant represented.

Out of the 40 species displayed, the informants identified a total of 21 plant taxa and five plant groups (Table 2). The informants had names for certain plant groups, while for other plants they gave names on the species level. Especially grasses (Poaceae spp.), sedges (*Carex* spp.), willows (*Salix* spp.) and birches (*Betula pubescens* spp.) were referred to solely with group names by the majority of the informants.

Plants, which were identified by name, were also often claimed to be grazed by reindeer (Table 2). The mean number of plants identified by name by the individual informants was 15.1 $SD \pm 1.7$ plants (15.3 $SD \pm 1.9$ in the mountain

reindeer herding communities and 14.8 $SD \pm 1.5$ in the forest reindeer herding community), and the mean number of plants that were identified as food plants was 13.6 $SD \pm 3.3$ (14.4 $SD \pm 3.0$ and 12.3 $SD \pm 3.8$ in the mountain and forest reindeer herding, respectively).

Out of 14 Sami speaking informants, eight chose to use the Sami language in their responses. All the 17 informants used some Sami words and Sami plant names, even when the interview was done in Swedish. In the forest reindeer community it was apparently also common to use common or local Swedish names for some plant species. Most informants from the two Sami language areas (NS and LS) identified *Angelica archangelica* ssp. *archangelica*, *Betula nana*, *Betula pubescens* spp., *Eriophorum vaginatum*,

Oxyria digyna, *Rubus chamaemorus*, *Rumex acetosa* and *Vaccinium vitis-idaea* ssp. *vitis-idaea* with similar or identical Sami names. For example *Equisetum fluviatile*, on the other hand, had different names in the two language areas, and was recognised by all informants and identified with the names gorddet (NS) and oassje (LS).

Trees and shrubs

All tree and shrub species displayed were known either by species or group names by the informants. The informants clearly distinguished *Betula pubescens* ssp. from *B. nana* by name. Three of the informants used the Sami name lageš for the exhibited *Betula pubescens* ssp. *czerepanovii*. All the informants were shown pictures of different *Salix* species, but none of them distinguished the different species that were shown to them. One informant described and named the *Salix* species differently accord-

Fig. 3d Months reindeer graze *Eriophorum vaginatum*

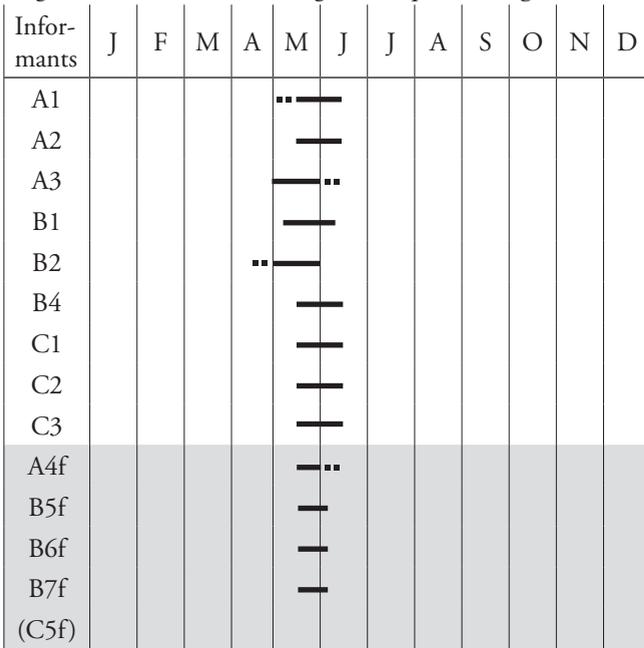
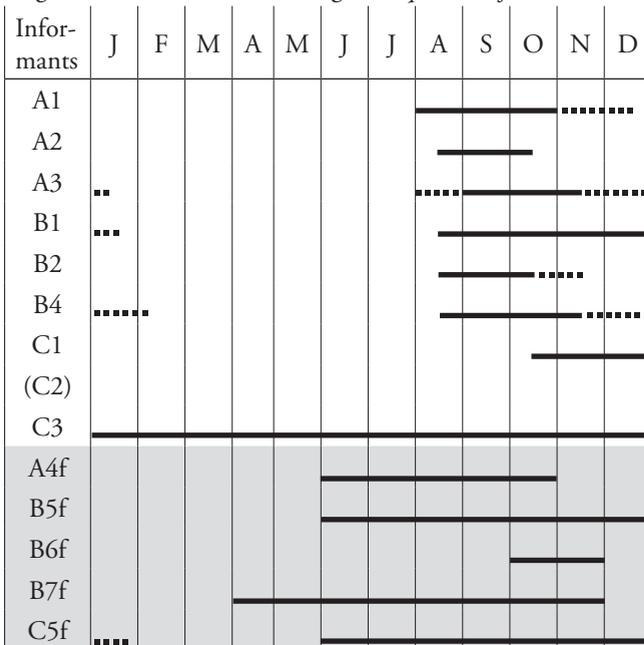


Fig. 3e Months reindeer graze *Equisetum fluviatile*



ing to leaf colour (grey or green), height and habitat (e.g. in forest) and also if they were living, dead or dry. Another informant named *Salix* spp. differently depending on whether

they were predominantly found in forest or mountain habitats.

According to all informants, reindeer commonly strip leaves of birches and willows. All informants agreed that the tree leaves were browsed during June to August. Especially in the forest reindeer herding community, September was also included (Fig. 2). Information about the condition of the consumed tree leaves was given by 11 informants: reindeer browse leaves which have fallen to the ground (4 informants), reindeer strip yellow leaves which remain on trees or bushes (4 informants), and reindeer take leaves when green (3 informants). The informants in the forest reindeer herding community considered leaves to be an important food resource in the summer along with other vegetation.

Vaccinium spp. and *Empetrum nigrum* ssp. *hermaphroditum* were almost always recognised by the informants (Table 2). The majority of informants considered *V. myrtillus* as a food plant, whereas they were less unanimous about the others. Sixty-six per cent of the informants from the mountain reindeer herding communities and 48% from the forest reindeer herding community were sure about that reindeer eat these dwarf shrubs (*Vaccinium* spp. and *Empetrum nigrum* ssp. *hermaphroditum*). The majority of the informants from the mountain reindeer herding communities indicated that this occurs from October–May

(Fig. 3a). Two informants out of five from the forest reindeer herding community indicated that reindeer graze dwarf shrubs in May and June (Fig. 3a).

Table 3. Scientific name	Grazing periods			Importance as fodder plant, occurrence in sample		
	Observed §	Rumen §§	Fistuled §§	Rumen #	Fistuled #	Utilization-availability, July ##
<i>Betula pubescens</i> spp.	IV-XII					
<i>Betula p. ssp. czerepanovii</i>	IV-XII					
<i>Betula nana</i>	IV-XII		<u>VII</u>		10-30%	Ru. -0.76 and Fist. +0.62
<i>Salix</i> spp.		<u>VI, VII, VIII</u>	<u>VI, VII</u>	10-30%	> 30%	
<i>Salix glauca</i>	IV-XII					
<i>Salix lapponum</i>	IV-XII					Ru. 0 and Fist. 0
<i>Salix phylicifolia</i>	IV-XII					
<i>Vaccinium myrtillus</i>	I-XII					Ru. -0.34 and Fist. -0.97
<i>Vaccinium uliginosum</i> ssp. <i>uliginosum</i>	sp, su					Fistuled 0
<i>Vaccinium vitis-idaea</i> ssp. <i>vitis-idaea</i>						Rumen -0.34
<i>Empetrum nigrum</i> ssp. <i>hermaphroditum</i>						Fistuled -1
Forbs				< 10%	> 30%	
<i>Angelica archangelica</i> ssp. <i>archangelica</i>	VI-VIII					
<i>Rumex acetosa</i> ssp. <i>acetosa</i>	VII-VIII					Fistuled +0.86
<i>Oxyria digyna</i>	VII-VIII					
<i>Rubus chamaemorus</i>						Fistuled 0
<i>Menyanthes trifoliata</i>	IV-XI					
<i>Epilobium angustifolium</i>	sp, su					
<i>Solidago virgaurea</i> ssp. <i>virgaurea</i>	su					Ru. +0.9 and Fist. +0.92
Grasses / Graminoids		<u>IV-VII, IX, X, XII</u>	IV,VI, <u>VII, X</u>	> 30%	10-30%	
<i>Deschampsia flexuosa</i> ssp. <i>flexuosa</i>	V-XII					Ru. -0.09 and Fist. 0
<i>Deschampsia alpina</i>	su, a					
<i>Festuca ovina</i>	VI-X					Ru. -0.27 and Fist. 0
<i>Poa alpina</i>	su, (a)					Ru. +0.79 and (Fist. -1)
<i>Eriophorum angustifolium</i> ssp. <i>angustifolium</i>	(w), sp, su, a			10-30%	< 10%	Rumen +0.43 and (Fist +0.23)
<i>Eriophorum scheuchzeri</i>	sp, su, a					Fistuled +0.87 (Fist -0.99)
<i>Eriophorum vaginatum</i>	V-XI					
<i>Eriophorum</i> spp. / <i>Carex</i> spp.			IV,VI, VII			
<i>Carex</i> spp.		I, IV, <u>VI, VII, IX, X, XII</u>				
<i>Carex aqualitis</i>	V-XI					(Fistuled 0)
<i>Carex bigelowi</i> ssp. <i>rigida</i>	VI-X					Ru. +0.11 and Fist. 0
<i>Carex rostrata</i>	V-XI			10-30%	< 10%	
<i>Equisetum fluviatile</i>	VI-XII					
<i>Equisetum variegatum</i>						(Fistuled -0.81)

Table 3. Compilation of scientific information on when different plant species are grazed by reindeer and their values as fodder for reindeer. The collection of plants follows the informant identification of reindeer fodder plants. Some of the plants have not been identified by the informants as a species but belongs to a group of plants (see Table 2). Plant taxonomy follows Mossberg & Stenberg (2003).

§ Skuncke (1958,1965): Months when the species is grazed is indicated with Roman numbers (I–XII) and seasons with w=winter, sp=spring, su=summer and a=autumn.

§§ Gaare & Skogland (1975): Fistuled = oesophageal fistulated reindeer used for sampling grazed plants during months: I, IV, VI, VII and X; Ru = rumen samples collected during months: I, IV, VI, VII, VIII, X and XII. Only months where sample contained more than 1% of the species are given and months where the species comprising more than 10% of the sample are underlined.

Gaare & Skogland (1975): occurrence of species in percent of the sample: Fistuled=oesophageal fistula collected during months: I, IV, VI, VII and X, and rumen samples collected during months: I, IV, VI, VII, VIII, X and XII.

Table 6, 7 and (8) in Skogland (1980), utilization-availability analysis of samples from rumen and from oesophageal fistuled reindeer (Fistuled) collected in July. Analyses in parenthesis are samples from Prudhoe Bay in Alaska (Table 8) and the other are from Hardangervidda in Norway. Species preferred by reindeer have values > + 0.5, and species of little interest for the reindeer have values < - 0.5

Forbs

No differences in patterns of answers could be distinguished in relation to age of the reindeer herders or type of reindeer herding practiced.

Seven out of 15 forbs (*Angelica*, *Bistorta*, *Cicerbita*, *Cirsium*, *Comarum*, *Epilobium*, *Filipendula*, *Geranium*, *Melampyrum*, *Menyanthes*, *Oxyria*, *Potentilla*, *Rubus*, *Rumex* and *Solidago*), i.e. the underlined 7 forbs were recognised with or without name by the most informants. *Solidago virgaurea* was named by 2 informants, and additionally 2 other species were recognised by name by about half of the informants (Table 2). The other 8 species appeared unknown to the herders and consequently were not considered to be a part of reindeer diet. One informant held that *Solidago vigaurea* grows in old corrals, or where there has been

much trampling by people and animals.

The herders' ability to identify three forbs (*Angelica*, *Oxyria* and *Menyanthes*) was shown to have a specific pattern, where species were either well known or unknown in the different reindeer-herding systems. *Angelica archangelica* ssp. *archangelica* was divided into two different types by 10 informants from the mountain reindeer herding communities and one from the forest reindeer herding community (Table 2). The fully grown and flowering plants were called boska, and those with only leaves were named fádnú or bellni in the Sami language. Most (11) of the informants said that reindeer graze the plants as fádnú/bellni, but not as flowering plants, although one claimed they browse the leaves of the flowering plant and another pointed out that the reindeer graze it in the early summer in the bud stage (Table 2). *Oxyria digyna* was named by 7 out of 11 informants from the mountain reindeer herding communities and 9 of them said that it is a food plant. In the forest reindeer herding community only one informant out of 6 named the plant and identified it as a food-plant. On the other hand, *Menyanthes trifoliata* was known in the forest reindeer herding community. Five out of 6 informants referred to it with the Swedish local name "missne" and 4 of them identified it as a food plant as well. Eight out of 11 informants in the mountain reindeer herding communities claimed that they recognised the species, and 3 of them named the species but with three different names. Four informants in the mountain reindeer herding communities identified it as a food-plant.

Grasses, sedges and Equisetum spp.

Grasses were named as a plant group and recognised as reindeer forage plants by all informants.

The Sami names were rássi and sitnu, where rássi had a wider definition. Sitnu appears to be the commonly known term in relation to rein-

deer grazing and was used by all informants. One informant from a mountain reindeer herding community claimed that *rássi* means everything that is green in the summer, except blooming herbs, shrubs and trees, while another only included grasses and sedges during summer in *rássi*. A third informant included grasses and *Equisetum fluviatile* as *rássi*. Two informants from the forest herding community included only *Carex* spp. as *rássi*. Twelve informants claimed that *rássi* is grazed particularly during the snow-free period. The informants from the forest reindeer herding community reported on an earlier start of grazing *rássi* than the mountain reindeer herding communities. (Fig. 3b). The term *sitnu* appeared to represent different grass species like *Deschampsia flexuosa*, *D. alpina*, *Festuca ovina* and *Poa alpina*. Eleven informants, who defined *sitnu* in more detail, said that it is “good grass” for reindeer. Eight of them also said that it should be short, and two said that there should be no flower heads on the plant. Eight informants said that *sitnu* grows throughout the year and could also be grazed beneath the snow during winter.

Thirteen informants indicated when during the year they think that the reindeer graze *sitnu*; the majority of them claimed that it was grazed during months with snow cover (Fig. 3c). One informant claimed that *Vaccinium vitis-idaea* and *sitnu*, both being green during the winter, are as valuable as lichens.

Eriophorum vaginatum was recognised by all informants except one, but no one recognised the species *Eriophorum scheuchzeri* and *E. angustifolium* ssp. *angustifolium* from the pictures shown (Table 2). According to all informants, reindeer graze *E. vaginatum* in May and early/mid-June (Fig. 3d). Eleven of them used the Sami name *gieganjuolla* for the recognised species.

According to all informants, reindeer like to graze *Equisetum fluviatile* (Table 2). The species was not confused with any other species. The informants also claimed that reindeer graze it

even after that snow had come if the plants were still erect. A difference between forest and mountain reindeer herding communities was found concerning when they considered that reindeer graze *Equisetum fluviatile* (Fig. 3e). Four informants in the forest reindeer herding community said that the reindeer graze it during summer and autumn and one mentioned October and November. According to 6 informants in the mountain reindeer herding communities the reindeer start to graze *E. fluviatile* in August, one informant indicated October and another claimed that they eat it throughout the year.

For comparison, a compilation of scientific information in the literature on when the plant species presented to the informants are grazed by reindeer and their values as food for reindeer is given in Table 3.

Discussion

The responses agreed upon in all sampled reindeer herding communities suggest that the results reflect a general status of traditional knowledge concerning reindeer forage plants in the northern part of the Swedish reindeer herding area. Possibly they may be indicative for the whole Sami reindeer herding area.

Only about half of the plants shown to the informants were recognised by species names. Generally the plants, which were recognised or in which interest was shown, were either said to be food plants or not known if they were food plants. Only a few species were claimed not to be used by reindeer, without any particular pattern in these answers. It seems that plants considered highly attractive for reindeer were commonly known by name (Tables 2 and 3). The informants also knew those plants by name, which were common in their own reindeer herding community (Hultén, 1971), like *Oxyria digyna* in the mountain reindeer herding communities and *Menyanthes trifoliata* in the forest reindeer herding community.

Besides a few conspicuous species, the plants that were most frequently known by name were those which are traditionally also used as human food. Examples are *Angelica archangelica* ssp. *archangelica*, *Rumex acetosa* (Fjellström, 1964), and berries of *Vaccinium myrtillus*, *V. vitis-idaea* ssp. *vitis-idaea* and *Rubus chamaemorus* (Table 2). Most informants (82%) were sure that reindeer graze *Rubus chamaemorus* and three of them claimed that the berries were also eaten by reindeer. These results agree with findings in samples from oesophageal fistulated reindeer (Skogland, 1980), but do not agree with Skunke's (1958) observations (Table 3). The plants used for human consumption were generally also claimed by the informants to be food plants (Table 2).

Grasses and sedges, which are more difficult to distinguish as species but are well known as plant groups, were unambiguously mentioned to be food plants. Other studies also stress the importance of grasses or graminoids as plants grazed by reindeer (Table 3). The naming of grasses and sedges differed from other species by being classified by the informants according to stage, appearance or use by reindeer rather than by species. The informants divided grasses into two types. One of them (*sitnu*) was defined as short grass without stalks which also remains green during winter, likely including more than one wintergreen species of grass (Qvigstad, 1901; Lönnberg, 1909; Nielsen, 1979). According to later scientific literature, *sitnu* is limited to *Deschampsia flexuosa*, which however might be a misunderstanding of the traditional naming (Wahrenberg *et al.*, 1997; Skuncke, 1958). The acquaintance with *sitnu* by scientists has perhaps been made in a forest reindeer herding environment, where *Deschampsia flexuosa* is a quite common grass species. The term *rásse* for grass was defined as green forage including forbs as well, and grazed only during the growth season (Fig. 3b and Table 3).

According to modern Lule Sami dictionaries, *rásse* (*rásse*) means grass (Korhonen, 2006), while *rásse* in North Sami also include herbs (Svonni, 1990). Older records show that *rásse* was once also used for dried *Angelica archangelica*, and that *rásse* means "to harvest *Angelica archangelica*" (Linnaeus, 2003 (1732); Qvigstad, 1901; Nielsen, 1979). Today, blooming *Angelica archangelica* is known by the name *boska*. The plant without buds has also been called *fádnu* (Linnaeus, 2003 (1732); Qvigstad, 1901; Nielsen, 1979) and this name is still in some use among the Sami. This high level of detail implies that *Angelica archangelica* was important to the Sami, who used it in their own fare and also knew that the plant is attractive to the reindeer (Fjellström, 1964). The Sami also knew that *Angelica archangelica* could be used to entice tame reindeer bulls to approach humans (Kuhmunen, 1968).

The method of asking the reindeer herders to identify plants from pictures has some limitations, and the herders could probably have identified more plants if they had seen them in their natural environment. However, the chosen procedure made the answers more easily interpreted as they were given under as equal conditions as possible. It would have been difficult to eliminate differences between responses if the interviews had been carried out in the field, especially considering that informants came from different geographical areas and were fairly few from each area.

The used photographs from Wahrenberg *et al.* (1997) were taken at varying times in the summer, and not always during the period when reindeer normally graze on the plant shown. *Eriophorum vaginatum* was depicted both in blooming and later in the season, *Eriophorum scheuchzeri* and *E. angustifolium* ssp. *angustifolium* were only presented to the informants as they appear in late summer. The reindeer herders had probably identified more plants if they were photographed during the spring or at the

season when the plant normally is grazed by reindeer. This possibly explains why *Eriophorum scheuchzeri* and *E. angustifolium* ssp. *angustifolium* were not acknowledged to the same extent as *E. vaginatum*, even though research has shown that all three species are eaten by reindeer and that *E. scheuchzeri* is the preferred one (Table 3).

Names used for the same species of plants may differ from one area to another, but the same name may also be used for different species. As an example, gieganjuolla is used for both *Eriophorum vaginatum* and *Epilobium angustifolium* ssp. *angustifolium* (Wahrenberg *et al.*, 1997) in North and Lule Sami languages. The plant *Polygonatum verticillita* in southern Troms county in Norway has also the name giega-njuolla (Qvigstad, 1901). The word giega-njuolla, means cuckoo-arrow in Sami, and seems not to be a specific name for one species of plant, but rather a general term for species that grow early in the vegetative season. However, the plant *Polygonatum verticillita* probably does not include plants that are grazed by the reindeer because it is poisonous (Mossberg & Stenberg, 2003).

Herders generally seemed to have opinions that agreed with each other about when reindeer prefer to graze different species. In some cases there were differences in opinions about some species between herders in mountain and forest reindeer herding communities. An example is *Equisetum fluviatile*, which was claimed to be used at different periods (Fig. 3e). Other examples are the uncertain information about the use of dwarf shrubs as food species in the forest reindeer herding community (Fig. 3a), while all informants in the mountain reindeer herding communities considered them to be used by reindeer. This may indicate either differences in the use of the particular species or differences in the period when reindeer could be observed to graze the species. In this respect it seems plausible that the herders' knowledge

is limited to the conditions in their own herding area and sometimes limited to the periods when they usually work closely with the reindeer.

The informants from the mountain and the forest reindeer herding community disagreed on some points, most notably during which periods the reindeers graze upon certain food plants. These differences arise naturally because reindeer herding is practiced in different biotopes during summer. Since forest reindeer herding is carried out in forested areas all year round, these reindeer graze on species in the forest and wetlands during periods when reindeer in mountain reindeer herding communities feed on plants in alpine areas above the timberline.

When the informants showed opinions about the use of plant species by reindeer, this generally agreed with the suggestions in the scientific literature in the sense that the individual species were either recognised as food plants or not known to be such, but not recognised as non-food plants (Skunke, 1958; Gaare & Skogland, 1975; Wahrenberg *et al.*, 1997). These may however not be incontestable proof of agreement with scientifically derived knowledge, since at least the suggestions by Skunke (1958) and Wahrenberg *et al.* (1997) may be partly influenced by previously collected traditional knowledge. Gaare & Skogland (1975) and Skogland (1980) based their results on rumen and fistula samples collected with the help of oesophageal fistulated reindeer, however (Table 3).

Quite unexpectedly, the knowledge about food plant species generally appeared to be vague and incomplete among the informants. Although management focus in reindeer pastoralism could be expected to be the ranges rather the animals used to harvest them, the plant species level is apparently not the relevant level during the snow-free season from the herders' perspective. The winter season

might be different, since the availability of a few species of ground and arboreal lichens are of fundamental importance for the survival of reindeer on natural pastures in Swedish reindeer-herding areas (Nissen, 1921; Skjenneberg & Slagsvold, 1979 (1968); Inga, 2007). The summer grazing conditions are also considerably less problematic than the winter grazing conditions, which may explain the comparable sparseness in the detail knowledge about summer grazing conditions (e.g. Skjenneberg & Slagsvold, 1979 (1968)). There are less reason for the herders to acquire detailed knowledge about plant species in the luxury situation. It may be the opposite during winter when the availability of food is more scarce and causing more concern for the herder.

In the extensive type of reindeer herding practised during the last hundred years or more, the herders have close contact with the animals only when handling them in gatherings and roundups, and during the winter grazing period when the animals are fairly closely guarded (e.g. Skjenneberg & Slagsvold, 1979; Paine, 1994). During all other times the reindeer are allowed to freely search for suitable forage themselves. Especially the herding during summer and autumn until rut in October is typically limited to guarding the borders of the entire summer herding areas. The knowledge may therefore also be limited due to less contact with reindeer during periods of grazing.

In conclusion, the knowledge on the plant level appears to be considerably less detailed than for example the traditional knowledge and terminology about the reindeer, their behaviour and the handling of them (e.g. Ruong, 1968; Kuhmunen, 1968; Collinder, 1984; Eira, 1984). The number of terms in each of these areas span from tens to hundreds. Similarly there is a rich terminology for snow and snow conditions, with more than three hundred documented terms (e. g. Jernsletten,

1997; Ruong, 1964; Ryd, 2001). A suggestion is therefore that the knowledge needed in the current extensive type of reindeer herding is on a broader scale than our interviews, e.g. as characteristics of valuable seasonal habitats or on landscape level, rather than in terms of specific species needed in the reindeer summer diet.

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Traditionell ekologisk kunskap bland renskötande samer i norra Sverige om kärlväxter som betas av ren

Abstract in Swedish / Sammanfattning: Traditionell kunskap om hur renen nyttjar betesväxter förväntades vara avgörande för renskötare. Sjutton samiska renskötare i fyra samebyar i Sverige blev intervjuade om 40 olika växtarter. Förutom att identifiera och namnge växterna ombads informanterna också tala om och när renen betade dem. Bland de 40 växtarterna identifierade informanterna sammanlagt 21 växtarter och fem växtgrupper. De lade särskilt märke till de arter som de själva använder i sitt eget kosthåll, men vissa speciella renbetesväxter kunde de också identifiera. Arter som identifierades som renbetesväxter av renskötarna var sådana som också betecknas som renbetesväxter i vetenskaplig litteratur. Detaljerad kunskap om kärlväxterna på artnivå var oväntat översiktlig, vilket kan indikera att kunskapen om barmarksbetesresurserna på en detaljerad artnivå inte är av vital betydelse. Detta står i skarp kontrast till den detaljerade kunskapen som samer har då det t.ex. gäller renen (som djur) och om snö (som fysiskt element). En tänkbar förklaring är att identifiering av individuella växtarter är en onödigt detaljerad information i en sådan storskalig pastoralism där renarna betar fritt och vallas i huvudsak genom kantbevakning utan direkt nära kontakt med djuren.

