

Chapter 4

Sámi Traditional Reindeer Herding Knowledge Throughout a Year: Herding Periods on Snow-Covered Ground



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Abstract Sámi traditional reindeer herding knowledge is the basis decisions in time and space made by Sámi reindeer herders with emphasis on periods and cycles and related to reindeer husbandry on snow-covered land. This chapter outlines aspects of the Sámi traditional knowledge used by reindeer herders in Western Finnmark performing reindeer herding during periods with snow on the ground. We will highlight the periods from October till April, as these constitute the critical bottlenecks in the annual herding cycle. Using methods for communicating with herders and co-production of knowledge between reindeer herders and science, this chapter outlines traditional reindeer herding periods and cycles through the year focusing particularly on aspects of herding on snow-covered ground. Reindeer herding strategies and practices are highly complicated and systematic enterprises containing different types of knowledge on how the biological and gender-based behavioral aspects of reindeer and the movement of the reindeer in time and space are connected to climate, temperature, and snow metamorphism. This includes knowledge about the different seasons, cycles, and periods in a reindeer year. Reindeer herding periods and cycles contain different sub-cycles that are a part of a larger system based on the year, the lunar month and day/night, e.g., cycles related to the use of areas throughout the year; the biological cycles of reindeer, like rutting season, calving season, dropped or cast antlers and moulting fur; sexual behavioral cycles; cycles relative to climate and snow, the cycles of sexual maturity, cycles of extreme years and cycles that include reindeer herding periods throughout the year.

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S. D. Mathiesen et al. (eds.), *Reindeer Husbandry*, Springer Polar Sciences,
https://doi.org/10.1007/978-3-031-17625-8_4

Keywords Sámi traditional reindeer herding knowledge · Herding periods · Seasonal cycles · Reindeer year · Co-production of knowledge · Snow-on-the-ground

4.1 Introduction

A saying among Sámi reindeer herders is that “reindeer are the easiest animals to understand” according to time and space. Naturally this presupposes a type of intimate knowledge among those who work with reindeer daily. The environment is based on the premises of nature, climate and determinations on how grazing areas can be used, setting the framework for reindeer husbandry.

Sámi reindeer herding is a livelihood and way of life, based on a versatile utilisation of various resources within an annual cycle. A part of the cycle is how to use land during the different seasons. The reindeer herd’s annual cyclic route – like moving from summer to winter pasture areas – allows for utilising many types of natural resources (Benjaminsen et al., 2016). This is subject to certain rules and is mainly controlled by natural phenomena, but particularly based on the needs of the reindeer (Mathis Nilsen Eira in Finnmarkskommisjonen, 2019). However, this is a way of life and nutritional adaptation with roots far back in time, shared with several other reindeer herding groups in the Circumpolar North (Benjaminsen et al., 2016).

The variations of the seasons and the reindeer’s learned behavior to migrate between and remain in the same areas at different times of the year is the ecological understanding of reindeer husbandry as a pastoral nomadic way of life (Eira et al., 2016; Sara, 2001: 81). Reindeer husbandry is based on an annual cycle that includes migrations between seasonal pastures where moving and migration are part of a basic principle for land use in reindeer husbandry, namely as part of the principle of alternation (see e.g., Reinert et al., 2009). Reindeer nomadism is therefore not a random act. As emphasised by Sara (2001), it is a carefully coordinated enterprise that requires consideration of several factors – grazing, climatic conditions, season, reindeer habits and annual cycle, presence of other reindeer herds and the like. Reindeer herders use knowledge related to the management of the individual animal as a resource and the relationship between animal herds and natural environments, and reindeer in combination with the exercise of control over separate herds throughout the annual cycle in different types of natural environments and under different weather and climatic conditions (Sara, 2001: 10–11). This knowledge forms the basis for reindeer herding world view which shapes and gives meaning to the observations and herding management. (Turi, 2016: 20).

A reindeer is controlled by its biological clock, time, landscape, and weather. Its movements and roaming are determined by pasturing (Eira, 2012) and avoiding threats at different times of the year. Reindeer graze in different areas throughout the year, going from one spring season to the next. The reindeer year is divided into eight seasons, and the seasons determine how reindeer herding is to be managed, how the herder or herding group makes tactical (short term) and strategic (longer

term) decisions. This represents the core of the adaptive capacity of the system. (Oskal et al., 2009).

Reindeer herders have experience and knowledge of how the reindeer cope and adapt to different situations through the year (Tyler et al., 2007), as well as knowledge of how the reindeer evolved by nature to meet and utilise the different seasons in the best possible way (Turi, 1998). Indigenous researchers also in relation to studies on reindeer herding have in the recent past used the definition of traditional knowledge made by the permanent participants (i.e., indigenous organizations with special status) in the Arctic Council (2015):

Traditional knowledge is a systematic way of thinking and knowing that has been developed and applied to phenomena across biological, physical, cultural and linguistic systems. Traditional knowledge is owned by the holders of this knowledge, often collectively, and is uniquely expressed and transmitted. Knowledge is generated through cultural practices, lived experiences, including comprehensive multigeneration observations, lessons, and skills, which have been developed and verified over millennia and are still undergoing development in a living process, including knowledge acquired today, and in the future, and it is passed down from generation to generation. (Arctic Council Permanent Participants, 2015)

This definition highlights the historical creation, holism, and current and future nature of such knowledge. In this paper this is the definition we will adhere to when we talk about reindeer herding knowledge. Sámi reindeer husbandry has also recently been defined by Norwegian supreme law as *Sámi reindeer herders' cultural practice* (NHR, 2021). This practice can thus be understood as an expression of the practice of the Sámi reindeer husbandry and the foundations that lie in the Sámi reindeer herders own understanding of what sustainable reindeer husbandry is (see Johnsen et al., this volume, Chap. 3).

However, we will use the term indigenous traditional knowledge (ITK) to denote such knowledge in general, and Sámi traditional reindeer herding knowledge to denote the knowledge in Sámi reindeer herding in particular. This choice is made to induce clarity of the concept of knowledge among indigenous livelihoods. The indigenous traditional knowledge in Sámi reindeer herding is expressed in different situations in time and space; it has to do with the year, variants of years, the day, the weather and other cycles that are important for herding. These cycles and time periods dictate work in reindeer husbandry. A cycle here is defined as a period in which phenomena are repeated in the same order, and is used in several disciplines (e.g., the *solar cycle* in astronomy as described by Aksnes, 2020). Yet there is limited work done to explain reindeer herding periods. This paper is a contribution to such work.

This chapter explores aspects of the Sámi traditional knowledge used by Sámi reindeer herders in Guovdageaidnu (Kautokeino) in Northern Norway throughout a year, with special emphasis on herding during periods on snow-covered ground in focusing on Sámi traditional knowledge the aim is not to travel backward in time but to understand indigenous traditional knowledge-based strategies and applying this to the current situation (Turi, 2016). Our goal is to investigate aspects of knowledge sectors that form the basis for decisions made in time and space by Sámi herders

with emphasis on periods and cycles and related to reindeer husbandry on snow-covered land.

This study was done in Guovdageaidnu, a reindeer herding region in Western Finnmark, which is characterised by topographic diversity, tundra, and woodlands; it is the largest reindeer herding area in Norway. We applied a social-ecological framework (Berkes, 2012) connected to acquiring knowledge using reindeer herders' professional language (Eira, 2012). The area was selected based on its presence of Sámi traditional reindeer herding knowledge and potential relevance for other reindeer herding and nomadic communities. The study was conducted through participatory research, following a bottom-up approach focusing on locally defined categories and perspectives (see also Johnsen et al., 2017). The study team consisted of two scientists with background from Sámi reindeer herding families in West Finnmark and one expert Sámi traditional reindeer herding knowledge holder with long-term expertise in reindeer herding in Western Finnmark. All narratives are provided by elders, the communications and collaboration meetings of the study team were conducted in Northern Sámi language, which enabled the fluent use of reindeer herding terminology and concepts in its original language. This constellation enabled a co-productive approach to documentation of reindeer herding knowledge-base, thus developing knowledge, based on scientific methods and indigenous traditional knowledge. The constellation of authors enabled in-depth discussion on data and analysis that may have otherwise been difficult (see e.g., Turi, 2016), by enabling co-production in science and indigenous traditional knowledge.

Data collection was based on expert analysis by our indigenous knowledge holder, interview data and narratives are provided by 34 reindeer elder herders conducted between 2007 and 2009 (resulting in 800 pages of transcription) and literature and policy review. The focus has been on defining and analysing concepts that are used by reindeer herders themselves (Eira, 2012) and are based on the experience and developed indigenous traditional reindeer herding knowledge (see e.g., Meløe, 1997).

The chapter is organized as follows; The section below, 4.2, outlines our literature review on concepts of time in reindeer herding. Section 4.3 explains the Sámi traditional reindeer herding knowledge of herding periods through the year. Section 4.4 outlines 5 herding periods during the snow-covered parts of the year. Finally, Sect. 4.5. discusses and provides our conclusions of this study.

4.2 Concepts of Time in Sámi Traditional Reindeer Herding Knowledge

This section outlines the concepts of time in Sámi traditional reindeer herding knowledge, focusing on Guovdageaidnu, our area of study. The section is based on our literature review based on sources from earlier research and outlines understanding of time in reindeer herding.

4.2.1 *Understanding of Time in Reindeer Herding in Guovdageaidnu*

In reindeer herding, there is ambiguity in relation to seasons, and focus is on work activities and times these need to take place. The practical reindeer herding calendar is therefore not directly correspondent to the Gregorian calendar's time divisions such as months or weeks.¹

The understanding and practise of the reindeer's life cycle is its basic need for access to food and water, space for rest and shelter and space for physical activity (Eira, 2012). This is a part of an annual cycle through a season and through day-night periods, and includes variations like grazing, resting, rutting, calving, snow-fall, snowmelt, hot weather and the prevalence of predators and insects. There are also activities which derive from human needs for organizing herds, such as identifying animals, earmarking, slaughtering, castration, separation, moving herds and training animals for transportation and other needs (Maggä et al., 2009).

The time calculations are often based on the working year and how nature changes throughout the year. When calculating time, the moon was used to calculate shorter periods and the sun was used to calculate longer periods. (Gaup, 1995; Granlund & Granlund, 1973). The old Sámi calendar contained 13 months (Wiklund, 1895) but was later adapted to 12 months to correspond to the Gregorian calendar (Gaup, 1995; Lid, 1945). As highlighted by Granlund and Granlund (1973: 97–98), the old Sámi calendar relates to reindeer herding by in part showing how the weeks and months in the calendar are based on migration times, calving (*guottet*) and rutting (*ragat*). The Sámi names of the months often describe natural phenomena and apparent characteristics (see e.g., Leem, 1756; Wiklund, 1895). For reindeer herding, time and reindeer biology are very important, such as the time when the calves are born, when moulting. Therefore, some names of the months in the Sámi calendar describe phenomena directly associated with reindeer herding. For example, May is *miessemánnu* in Sámi (reindeer calf month), in which calves are born (Lid, 1945). *Borgemánnu* (August), says something about how the reindeer's fur changes. Further, *golggotmánnu* (October) refers to *golggot*, i.e., exhausted male reindeer (during the rut) (Eira, 2011; Maggä et al., 2001) and says something about a time when male reindeer have finished rutting and are exhausted afterwards (Sara, 1999). Other names for months say something about phenomena that are characteristic of the time in question, such as April (*cuoŋománnu*) describing snow conditions, translated to the month of dense snow/ice layer (Eira, 2012). Also, some weeks have names that refer to changes in nature throughout the year. In the summer months, reindeer husbandry uses names based on fur change that can be translated to thin fur cover, medium fur cover and thick fur cover (Sara, 1999). In other words, the understanding of time among reindeer herders in Guovdageaidnu contains

¹The Sámi traditional reindeer herding knowledge based herding calendar also differs from the administrative or governmental reindeer herding year in Norway, which starts in the beginning of April and ends at the end of March the following year.

characteristics and descriptions of the old Sámi calendar, the seasons, the solar year, the summer and winter half-years and names of weeks (See Table 4.1).

Indigenous reindeer herding is based on the optimal use of different seasonal pastures (Turi, 2009). Reindeer herds often follow an annual cycle moving between winter, spring, summer, and autumn pastures (Eira, 2017). Seasonality is independent of geographical location and is somehow ubiquitous across the globe. In habitats in the temperate northern and southern hemisphere there have been categorised four seasons (spring, summer, autumn, winter); in tropical habitats there are only two (dry and wet) seasons (Chapman et al., 2014). In Sámi reindeer herding habitats

Table 4.1 Traditional understanding of time in Guovdageaidnu

Cycle	Time	Characteristic	Description	Sources
Ancient Sámi calendar	13 months	Names of months are named after reindeer husbandry, except Christmas month, New Year month and February	The first part of the word refers to important epochs in the year cycle Refers to changes in nature and life created by the year In a year with 12 months there are almost 13 new moons. Therefore, the Sámi year has 13 months	Leem (1756), Stockfleth (1852), Wiklund (1895: 96), Lid (1945: 130) and Grundström (1950: 51)
Seasons	8	The natural changes throughout the year	Compound names for parts of seasons such as <i>gidđadálvi</i> (spring-winter); <i>čakčageassi</i> (late summer)	Wiklund (1895: 96) and Sara (1999)
Solar year	4	Summer solstice, autumn equinox, winter solstice and spring equinox	When the sun is directly in the south at noon, in the west in the evening, in the north at midnight and directly in the east in the morning, both the compass direction and the division of the day into four is visible	Sara (1999)
Summer and winter half years	2	This division also gives the direction of movement in space throughout the year	North and South refer to topographical alternatives, i.e., the summer half-year-area and winter half-year-area	Gaup (1995) and Sara (1999)
Names of the weeks	52 21 in research area	In a Sámi understanding, all the weeks of the year have their own names. In Guovdageaidnu there are names for 21 weeks, starting from mid-summer lasting to Advent	Accounts of the yearly changes or events in nature one can expect and the week in normal years	Gaup (1995), Sara (1999), and Qvigstad (1888: 97)

Table 4.2 The reindeer herding seasonal cycle

Reindeer herding season	Approximate months	English translation
<i>Dálvi</i>	December–March	Winter
<i>Giddádálvi</i>	March–April	Spring-Winter
<i>Gidda</i>	April–May	Spring
<i>Giddageassi</i>	May–June	Spring-Summer
<i>Geassi</i>	June–Aug	Summer
<i>Čakčageassi</i>	August–September	Autumn-Summer
<i>Čakča</i>	September–November	Autumn
<i>Čakčadálvi</i>	November–December	Autumn-Winter

or pasture areas, the reindeer herding year is divided into eight seasons (Eira, 2011; Manker, 1975) (see Table 4.2).

Autumn (*čakča*) and spring (*gidda*) are defined *year by year* by changes that are normal for these periods. Both summer and winter are divided into 3 periods each: pre-winter/autumn-winter (*čakča-dálvi*), mid-winter/winter (*dálvi*), late winter/ (*gidda-dálvi*), pre-summer/spring-summer (*gidda-geassi*), mid-summer/summer (*geassi*) and late summer/autumn-summer (*čakča-geassi*) (Manker, 1975). Each period affects reindeer behavior, as does the state of the natural surroundings, landscape, and weather. There are many changes to weather and the terrain throughout the year, and all operations must adapt to them accordingly. The rutting season and calving time have a natural biological connection with each other but are also dependent upon weather and snow conditions (Skjenneberg & Slagsvold, 1968).

4.2.2 Sámi Herder Knowledge of Grazing and Resting Cycles Throughout the Day/Night

Daily rhythms in movement and activity triggered by circadian cycles are the rule for many animals, but such movements require regular light/dark fluctuations and are lost when such stimuli disappear. For example, reindeer generally show circadian rhythms in movement and activity, but during periods of constant light (mid-night sun) or constant darkness (mid-winter) they lose their rhythm (van Oort et al., 2005).

Reindeer have a regular daily activity pattern, and they move to satisfy their grazing needs while also finding time to calm down and rest. In this the basic cycle is *jánddur* (day and night, 24 h). *Jánddur* is divided into the cycles of *guohtut* (grazing) and *livvadit* (resting). The reindeer herd has a grazing pattern characterised by scattered groupings with regular grazing and resting periods throughout the day/night. The number of resting periods may vary according to the time of the year. There usually are fewer resting periods on snow-covered ground (*muohtan*) than on bare ground (*bievlan*). According to N.I. Eira (1984) the reindeer usually graze for 3 h and rest for 3 h at certain times of the day or night during very good grazing

Table 4.3 *Livat* – Resting cycle of reindeer

	Names of different rest times in English	Autumn/Autumn-winter	Winter
03:00–06:00	Morning rest	Guovssolivat ~ beaive-badjánan-livat ~ idit livat: The reindeer's first morning rest in autumn	Guovsso-livat: The reindeer's morning rest in winter
09:00–13:00	Noon rest	Gaskabeaiv-livat: The reindeer's noon rest	Beaivel-livat: The day rest, the reindeer's evening rest in winter
16:00–19:00	Afternoon rest	Veaigelivat ~ eahkedis-beaivlivat ~ eahkesbeai-livat: The reindeer's afternoon rest in autumn	
	Evening rest	Guovssovuodjun-livat: The reindeer's evening rest in autumn	–
22:00–01:00	Night rest	Gaskaija-livat: The reindeer's night rest in autumn	Idja-livat – Night rest, the reindeer's evening rest in winter (ca 20:00–21:00)

Adapted from Nielsen (1979), Eira (1984)

conditions. Other times reindeer rest for approximately 2 h and graze for 4 h. There is, however, a difference in grazing and resting times between autumn and winter (Nielsen, 1979) which are expressed with different concepts (See Table 4.3).

The autumn/autumn-winter cycle usually has five resting periods: *Idit-livat* (morning rest) (also called *guovsso-livat* (daybreak rest), or *beaivebadjanan-livat* (rest at daybreak)); *gaskabeai-livat* (rest at midday), *veaige-livat* (rest in the evening) (also called *eahkedis-beivlivat* or *eahkesbeailivat*); *guovssovuodjun-livat* (rest when dusk disappears) and *gaskija-livat* (rest at midnight). There usually are fewer resting periods on snow-covered ground (*muohtan* ‘when there is snow’) than on bare ground (*bievlan* ‘when there is bare ground’) (Eira, 1984; Nielsen, 1979). The cycle is determined by, i.e., *veaigi* (twilight or dawn) and *guovssu* (daybreak). Reindeer herders use four main terms for the times of day/night: midnight (*gaskaidja*), morning (*iddesveaigi*), midday (*beaiveguovdil*) and evening (*eahkesveaigi*) that have consequences for herding (Eira, 2011). Reindeer herders know that the reindeer are most active at dawn, in the morning, at dusk, and in the evening. For example, *Eahkedisveaigi* (twilight) in Guovdageaidnu in January 2021 is at about 14:00 and *Iddedisveaigi* (dawn) is at about 09:00.²

All these Sámi concepts of time form the background for reindeer herding periods through the year. In the following section the periods during snow-covered seasons as defined by Sámi traditional reindeer herding knowledge are outlined.

²See e.g., Time and Date (n.d.) Kautokeino, Norge: Soloppgang, solnedgang og dagens lengde, oktober 2021, online: <https://www.timeanddate.no/astronomi/sol/norge/kautokeino> (accessed 26.10.2021).

4.3 Sámi Traditional Reindeer Herding Knowledge of Herding Periods Through the Year

This section and Sect. 4.4 present the results of our study and is based on communication with reindeer herders, including knowledge from co-author J.M. Turi.

In Sámi traditional knowledge on reindeer herding in Guovdageaidnu, the periods in a reindeer year are understood as periods of built-in cycles that repeat from year to year, and where some basic elements are always present. Parts of the cycles are related to patterns on grazing, well-being, calving, rutting etc. The patterns are governed by environmental factors such as climate, nutritional needs, and cycles where each cycle is related to another. Some cycles are easily observable like rutting and calving (Skum et al., 2016), while others, like the resting cycle (*livat*) (see also Table 4.1), are more intricate and require knowledge and experience to be fully understood. The patterns are also influenced by environmental factors, where flexibility and change are prerequisites for survival reindeer. Both traditional holistic knowledge and a herder's physical observations of snow play key roles in herd management (Eira et al., 2018).

According to Sámi reindeer herders, an important factor is always to have an overview of the herd and the animals that are away from the herd. There are also five key factors that characterise snow cover and snow type: (1) access to water, food, and space, (2) physical activity, shelter, and rest, (3) mobility for reindeer and herders, (4) visibility of tracks in the snow, and (5) visibility of animals and environment (See also Eira et al., 2010, 2018).

One tool that reindeer herders use is to anticipate situations. Herders anticipate conditions regarding climate, snow conditions, environment and use these to constantly adapt to new situations by knowing the nature of reindeer (in Sámi: *bohcco luondu*), its reflexes, moving patterns, reactions to external stimuli, typical behavior in relation to other reindeer, natural surroundings, and seasons. But even if reindeer herders use the predicting as a tool, one must remember that the natural environment is at one hand extremely predictable and repetitive, while at the other extreme, unpredictable, and shifting. In pastoralist thinking, the principle of flexibility or mental preparation for change is prominent and it must be adjusted to daily evaluations and decisions in relation to short-term and long-term pasture strategies. The environments related to herding and *siida* systems are open-ended. All this creates a kind of predictable unpredictability. But by using the reindeer herder's knowledge and the ongoing practice and changes in the socio-ecological system, herders can form and maintain the reindeer herd according to their own plan and pasture areas. The ability to anticipate is also used in different situations like the well-being of the reindeer, and this can best be understood in terms of cycles that are based on indigenous traditional knowledge of reindeer herding. Annual cycles in herding include a round of years or a recurring period and are displayed with seasons, months, weeks, time of day/night to be understood. According to Hyndman (2011), seasonal patterns are series that are influenced by seasonal factors like the quarter of the year, the month, or day of the week.

The development and behavior of reindeer follow a pattern that is determined by how the reindeer as a species is equipped to respond to its surroundings and the environment, i.e., the landscape, the vegetation, the varying food supply, and the varying climatic conditions throughout the individual parts of the year. It follows that there is a significant coincidence in development and behavior patterns of reindeer in the different geographical areas at different times of the year, but also some significant differences that relate to the combination of landscape, vegetation, nutrient supply, and climatic conditions in individual areas (e.g., snow conditions).

Although the year is divided into eight seasons, the herding season is a gender and behavior related division, which means that female reindeer have more and different periods than male reindeer. A reindeer year is thus divided into nine periods for female reindeer and eight periods for male reindeer. The one period that applies to females is period 5, the calving period. Simultaneously the males continue to follow 4. period, the spring period. As shown in Table 4.4 the periods are divided into weeks and in relation to approximate time.

Focus aspects of the reindeer herding knowledge and practices are dealing with the sustainability of nomadic husbandry and herding. These include issues like herd management, relationship to local landscape and natural environment (Ruong, 1964), knowhow and adaptation to varying climatic conditions, and knowledge processes, ethical considerations and decision making (Eira, 2012; Sara, 2013). Furthermore, as described by M.N Sara (2013), reindeer herding is a highly complicated enterprise. Control is never complete or guaranteed because the animals are self-sufficient and in continuous movement within a vast and complex landscape (Bull et al., 2001).

Summarized, a reindeer cycle and a period can contain week names, seasonal grazing areas – topographical sections, light/dark – moon, climate – weather and snow conditions, temperatures, the behavior of a single reindeer and the herd, herding systems, biological factors, age, gender, antlers, and other significant tasks, as outlined in Table 4.5.

Table 4.4 The reindeer herding periods of a year

Period	Name of the period	Approximate time
1	<i>Vuosttaš muohta ja njáhcu</i> (First Snow and thaw period)	Weeks 41–44
2	<i>Skábma</i> (dark time period)	Weeks 45/46 till week 2
3	<i>Dálvi</i> (winter period)	Week 50 till beginning of February
4	<i>Dálveguovdil</i> (mid-winter period)	Beginning of February till end of march
5	<i>Gidda</i> (spring period)	Beginning of April till end of May
6	<i>Guottet</i> (calving period)	End of April till <i>Jonssot</i> (June 24th)- end of June
7	<i>Geassi</i> (summer period)	End of June till middle of august
8	<i>Čakča-geassi</i> (Autumn summer period)	Middle of august till middle of September
9	<i>Rágat</i> (Rutting period)	Middle of September till <i>dálvevahkku</i> (from approx. October 14th)

Table 4.5 Contents of a reindeer herding cycle

Week Names – Sámi Month Names	Seasonal Grazing Areas	Topographical Sections	Reindeer Behavior
Antlers	Age – Gender	Grazing and Resting	Biological
Light – Dark	Climate – Weather	Significant Tasks – Moon	Snow Conditions
Temperatures			

4.4 Five Herding Periods During the Snow-Covered Parts of the Year

This section provides examples of the fundamental understanding of Sámi reindeer herd management during the snow-covered parts of the year. We have divided the reindeer herding year into 9 periods as described by reindeer herders (see Table 4.4), and out of these we will cover the 5 periods which are snow-covered. These are: *vuosttaš muohta ja njáhcu* (first snow and thaw period), *skábma* (dark time period), *dálvi* (winter period), *dálveguovdil* (mid-winter period) and *gidda* (spring period).

These periods form the basis for decisions made by herders in time and space on snow-covered ground. We will give examples of content for these periods. These cycles are described in narratives provided by elders from the herder communities on annual seasons and periods. They express the relationship between using Sámi reindeer herding technical concepts connected to seasonal cycles and the sequence of periods corresponding to land use, snow, reindeer biology and behavior.

The patterns in a *reindeer year* set the external framework for the Sámi reindeer herding which is conducted in the traditional way in certain geographical areas. Throughout the year, the seasonal grazing areas and the topographical sections strongly affect reindeer handling in a period. Periods in each cycle are related and dependent on each other.

In periods reindeer patterns are influenced by environmental factors that require continuous adjustments to maintain the best possible situation for reindeer. The cycles in reindeer herding change depending on area, environment, climate, sex and age of individual animals and the experience of individual animals and the herd as

a whole. Reindeer are standing in and using different types of terrain and landscapes, during the day, in different weather conditions. This requires reindeer herders to be able to read the terrain and weather to predict the different responses to the animals related to gender and age. This knowledge is used, for example, to find probable areas for reindeer that are temporarily missing, also described by Paine (1972). This shows the depth of knowledge displayed with the reindeer herders' technical language that is required for this activity. Reindeer herders use, i.e., several key concepts that are crucial to the understanding of how principles of interdependence between reindeer herd, personnel and pasture are managed. The concepts are derived from Sámi traditional reindeer herding knowledge and are organized chronologically from autumn-winter to spring-winter. An outline of key understanding shown by concepts is displayed in Table 4.6.

The herders play a crucial role in evaluating and observing the situation regularly during the day, every day during winter. This is about reindeer behavior on the snow, survival, sustainability, and the well-being of reindeer. Thus, knowledge of the annual biological and behavioral cycles of reindeer, land use, climatic conditions, snow, herding systems, and the relationship between these forms the basis of nomadic work with reindeer. Table 4.6 represents knowledge of grazing patterns during different seasons and topographies and weather conditions; wind and different snow conditions are particularly crucial for herd control (Eira, 2022; Paine, 1972). Snow physics, as shown in Table 4.6, have a significant impact on herding and grazing ability (Eira et al., 2018). On average there are 228 days a year with snow on the ground in Guovdageaidnu (Vikhamar-Schuler et al., 2010).

The knowledge of snow physics is part of the herder knowledge system for snow and ice. They articulate a comprehensive knowledge concerning snow physics that contains different snow characteristics like hardness, density, stratigraphy, layer thickness, snow depth, snow water equivalent and physical processes of snow that affect these (Eira et al., 2013). So, the denser the snow is, the harder it is for reindeer to dig holes in the snow and reach the grass/lichen, etc. below the snow (Eira, 2012) (see Fig. 4.1).

In the annual cycles of snow on ground, the snowpack presents a picture of the weather event from the time of first snow and consists of snow embedded in layers with different characteristics like order and thickness of layers within the snowpack. These are also highly significant for reindeer herders as they affect reindeer survival, sustainability and well-being, and human working conditions.

Throughout the winter in a winter grazing area, a *siida* may use more than 20 different topographic areas (Eira, 2012), affecting how the snow settles on different types of terrain/different landscapes and thus influences the reindeer in different ways (Eira, 2022).

The daily work with reindeer on snow-covered areas comprises many different types of activity – especially related to the herd, the herder and the *siida* – like “ecology, herding strategies, coordination of herding tasks and in relation to surrounding *siida* units” (Sara, 2009: 158). A part of the herding strategies during winter is to find food for the herd with the lowest possible energy expenditure for digging and movement, while controlling the herd. The herding strategy also

Table 4.6 Key concepts used by Sámi reindeer herders on weather and snow conditions and herding

Key concepts used by Sámi reindeer herders on weather and snow conditions and herding
<i>Bievla</i> : Condition with snow-free ground in early autumn and late spring
<i>Vuosttaš muohta</i> : The first snow deposited in the autumn that builds up the snow cover on the ground
<i>Dálvvi vuoddu</i> : The basis of winter. The snow on the ground in the autumn, variability of snow, weather, winds, temperatures and precipitation, melt/ freeze cycles, ice causes for how winter will be. The ideal situation in the autumn will be if soil is frozen before snow accumulates on the ground surface. The snow can thus thaw because the soil is frozen before the snow cover develops. Conversely, snow on warm soil can lead to the most critical grazing variables for reindeer
<i>Bodneskártá</i> : A result of a melt and freeze cycle occurring in late autumn/early winter when snow melts and the water freezes to form a hard coating of ice on the ground and plants. This condition will have a great negative impact on grazing possibilities in winter because it is almost impossible for the reindeer to penetrate the ice layer and thus reach the pasture (food)
<i>Golgu-njázut</i> : Slushy snow (<i>njáhcua muohta</i>), a combination of snow and liquid water occurring in connection with All Saints Day. This condition occurs because of alternating snow, higher temperatures and subsequent thawing. One can expect that it will become a bad winter with snow and subsequent rain in combination with large temperature fluctuations from minus to plus, and then colder temperatures. This will form ice layers (<i>geardni</i>) and at worst produce <i>bodneskártá</i> conditions
<i>Seanjáš</i> : Granulated snow with loose snow structure that forms at the bottom of the snowpack. This snow can provide good snow conditions for the reindeer and improve dense snow and thus better grazing conditions. When the herders know that the snowpack contains <i>seanjáš</i> , they know that it is easy for the reindeer to dig through <i>seanjáš</i> to the pasture plants beneath. <i>Seanjáš</i> develops in shallow snowpacks, usually at the beginning of the winter season when the temperature gradient is $> -10\text{ }^{\circ}\text{C}/100\text{ cm}$ snow depth
<i>Seakjūt</i> : The <i>seanjáš</i> -process that forms of because of large temperature gradients within the snow pack. This can change the dense snow consistency to <i>seanjáš</i> in very cold temperatures
<i>Oppas</i> : Snow condition in an untouched or untrodden area in winter. In this condition, the entire snowpack from the surface to the bottom includes loose snow, snow types like <i>vahca</i> , <i>luotkkomuohta</i> , <i>seanjáš</i> and thus have not been touched by reindeer when grazing
<i>Čiegar</i> : Snow condition with very dense snow in an area in winter. Such conditions occur because reindeer have been grazing in the area leaving cold grazing holes (<i>suovdnji</i>) in the snow. The process that makes <i>čiegar</i> is that the reindeer by grazing is destroying the snow crystal structure, so that the snow change, sintering process goes much faster
<i>Čearga</i> : Dense surface snow layer that can be from 5 cm to 1 m deep made by winds depositing hard-packed snow later of blown snow from January to April. The wind is transporting the snow, resulting in broken snow particles, and thus forming a strong and dense snowpack that can be so hard that neither reindeer nor people can dig through the snow
<i>Skávva</i> : Thin ice-layer at the surface formed by the freezing of sun melted surface snow. This occurs in spring-winter and spring. This is a part of the melt and freeze cycle, the stage before <i>cuoŋu</i> (strong crust on snow). The crust has strength enough to support the weight of people and reindeer. For migrating in spring, <i>skávva</i> can bring good travelling conditions
<i>Cuoŋu</i> : Ice layer which results from melt starting in mid-morning or early afternoon making <i>njáhcua</i> and freezing starting when the sun goes down. This belongs to the <i>cuoŋu</i> -cycle, i.e., melting followed by refreezing in spring-winter. This makes a hardened snowpack that obstructs reindeer in getting through the layer to the lichen but can bear both people and animals

(continued)

Table 4.6 (continued)

Key concepts used by Sámi reindeer herders on weather and snow conditions and herding
<i>Ruovdecuoju</i> : A very dense layer of ice that occurs when the snow has been softened up and then frozen during the night. It is a part of the <i>cuoju</i> -cycle
<i>Moarri</i> : A thin crust on the surface formed because of alternative thawing and refreezing. It is almost hard enough to support the weight of the reindeer, but not quite hard enough to support the weight of people. The crust is very sharp, and the reindeer avoids going into <i>moarri</i> because it cuts the legs/hooves when one breaks through. If the herders are trying to move the herd in <i>moarri</i> conditions, it becomes very difficult to do so because it is hard for the reindeer to move through this type of snowpack
<i>Goavvi</i> : Disaster event connected to snow conditions that cause starvation and death of reindeer, negative calf production (<i>miesehis jagit</i>) and less nutrition – which in turn affects the herders’ livelihood, economy, and psychosocial well-being. This appears during extreme weather events caused by a combination of different ice formations, amount of snow, dense and hard snow that is too hard for a reindeer to penetrate like ice (<i>jiekŋa</i>) layers on the surface or in the snowpack, ice frozen into the vegetation (<i>bodneskártta</i>), deep snow (<i>gassa muohta</i>), and wind-packed snowdrifts (<i>čearga</i>). These conditions can cause impenetrable pastures – often referred to as ‘locked’ pastures

Fig. 4.1 Reindeer grazing and making grazing pits in the snow (*suovdnji*). (Photo: I.M.G. Eira)



includes observing and monitoring snow conditions and the behavior and reaction of reindeer to different types of snow and ice on the ground, and snow in the air. This comprises the nature of the snowpack with different layers with unique characteristics in terms of density based on diverse snow crystals, amount of drifting, and the temperature in the snowpack, and influenced by snow metamorphism or the change of snow crystals over time (Eira, 2012, 2022).

A basic concept used in connection with herding on snow-covered land is *guodohit*, which is closely linked to *guohtun*, which describes grazing conditions and access to food through the snowpack: how easy or difficult it is for the reindeer to gain access to food by digging in the snow (see Fig. 4.2).

In winter, the snow conditions also are of importance for grazing and resting. When grazing conditions in snow are good (*buorre guohtun*) (Eira, 2012), these are more fixed in relation to the time of day than when grazing conditions are worse.

Fig. 4.2 Reindeer herder evaluating *guohtun* in the snowpack. (Photo: I.M.G. Eira)



Both grazing and resting times (see Table 4.3) and synchronization of the herd can change with the weather, reindeer-specific conditions, and the seasons. Grazing and resting times are nevertheless something that can be easily manipulated by the herders without creating significant problems. Here, however, it should be said that it is not always wise to manipulate these activity cycles. Manipulation of grazing and rest times often takes place during practical herding, for example when moving over long distances, or when the reindeer are corralled inside fences.

The approach and considerations necessary vary from year to year. There is a saying in reindeer herding that *Jahki ii leat jagi viellja*, 1 year is not another year's brother. This highlights the experience of variance between years, and that 1 year's climatic conditions do not follow the previous year (see also Tyler et al., 2007). The ecological seasons vary and therefore also the herding periods vary. It is necessary to take into consideration both variations through the year, and variations from year to year. Herding periods also overlap, as is especially evident between *skábma* and *dálvi* (Sects. 4.3 and 4.4). In addition, it is not possible to place these periods in exact week numbers. We have, however, included approximate week numbers and time frames for the periods.

4.4.1 *Vuosttaš muohta and njáhcun (The First Snow and Thaw Period)*

Vuosttaš muohta and njáhcun period (first snow and thaw period) begins after the end of *ragat*, the breeding season in the middle of October. A day of significance is the 14th of October, called *Dálveidja/dálvebeaivi* (winter-night/winter-day). The week of this date marks the beginning of the period. *Vuosttaš muohta* (See Fig. 4.3 below) and *Njáhcun* last from the middle of October to the middle of November.

As mentioned before, this period begins with the first snow, often appearing around the middle of October. The period is characterised by changing from *bievla*

Fig. 4.3 *Vuosttaš muohta* – The first snow.
(Photo: I.M.G. Eira)



(snow-free ground) to *muohta* (snow), that is of great importance for the rest of the winter. The first snow often melts again, but sometimes this snow stays and makes the snow cover on the ground. During this period the basis of winter is formed. The snow on the ground in the autumn, variability of snow, weather, winds, temperatures and precipitation, melt/freezing cycles, ice will make the basis for how the rest of the winter will be. The ideal situation in the autumn will be if soil is frozen before snow accumulates on the ground surface. The snow can thus thaw because the soil is frozen before the snow cover develops. Conversely, snow on warm soil can lead to the most critical grazing variables for reindeer.

In this period, reindeer herders anticipate a significant week *dálvevahkku* (winter week) October 8–14. Herders know that after this week, the climate will change with colder air and snow. Furthermore, herders also know that the behavior of the reindeer herd will change from hectic times to calmer conditions.

The period also includes weather characterized as *njáhcu*. *Njáhcu* is thawing weather, and occurs both in autumn and spring, and *njáhcu muohta*, wet slushy snow, that occurs as a result of alternating snows and thaws. This condition occurs because of alternating snow, higher temperatures and subsequent thawing and subsequently freezing.

Herders anticipate that snow and subsequent rain in combination with large temperature fluctuations from minus to plus will result in a bad winter. This rain and freezing will form ice layers (*geardni*) and at worst produce *bodneskártá* conditions (see Table 4.6 above). If the first snow has thawed and then frozen again it will turn (metamorphic) to ice. This will affect *guohtun*, as the lichen is frozen under the snow, sometimes throughout the whole winter until spring.

This period is divided into three subsequent weeks called; *Golggu-njázut*, *Simonvahkku-njázut* and *Hállemas-njázut*. These are around week 42–45. *Golggu-njáhcu*, denoted from the term *golgu*, refers to the time the male reindeer is exhausted after the rutting season. This normally occurs during weeks 42–43. Then follows *Simonvahkku-njázut* at the end of October. Finally, *Hállemas-njázut*, (derived from the Sámi word for All Saints Day on 1 November) comes on appr. week 44.

Reindeer herders have through generations been told that if the thaw does not occur in early November, it will be a bad winter and thus bad grazing conditions for reindeer. The prediction or anticipation for the winter is that no thaw in November can cause mild weather (with plus degrees) and periods of rain on snow. Such weather conditions cause ice layers in the snowpack and possibly the ground will be icing, which makes it difficult for reindeer to reach lichen under snow and ice. For example, In the beginning of November 2019, there was no thaw around the time of *Hállemas-njázut*. This caused hard pasture conditions already in the early winter of 2020 and these snow conditions were preventing reindeer to reach lichen. (See Johnsen et al., this volume, Chap. 3) Earlier the *Hállemas-njázut* corresponded with the calendar, occurring from 1 November. In recent years, however, this seems to have changed, as there has been no such thaw in November for several years due to climate conditions.

The weather in autumn to winter, especially in snow/ice types that occur in the autumn (like *bodneskártá*), has major consequences for *guohtun*. This condition will greatly impact grazing possibilities negatively in winter because it is almost impossible for the reindeer to penetrate the ice layer and thus reach the pasture/food. In 1910, Johan Turi (1931) described the transition from bare ground to snow-covered ground using some snow concepts and how these occur.

At that time, when the bulls are worn out, then it generally thaws, and that thaw is called *golggonjacco* (the debility thaw). And then you generally lose the herds because it is very bad weather, fog and rain, and when it thaws much there is bare ground in some places, and in other places the snow is left lying, and when it freezes, then that snow is turned to ice or, as it is called, *bodneskardan* (bottom crust), and it remains all through the winter just as it is at the time when the last thawing stop and the cold comes. But if the thaws do not spoil the snow, then it will be a good winter, unless there comes very deep snow, for the reindeer can get to the mosses even if the snow is fairly deep, if only there is a clean bottom, that is, no ice on the bottom. And it is at this time that the Lapps are afraid (wondering) what the winter will be. (Turi, 1931: 53–54)

During this period, the reindeer move more out of instinct (see also Eira, 2011: 44) and the reindeer herders know that reindeer generally move to areas that are in topographical sections like lowlands in this period, where dense vegetation is found. With this knowledge, the herder can predict how the reindeer will move in the terrain. Reindeer also tend to start moving fast after one other in a long line (*ruvgalit*) (Eira, 2011), and this makes it in general more difficult to herd and requires more from the reindeer herder. But whether the reindeer is calm or moves a lot will of course vary from year to year.

In this period, most of the *siidas* will migrate from the autumn pasture areas to winter pasture areas (Eira, 2011: 46). During the migration, the herders follow the reindeer rest cycles that include five resting periods. It is worth noting, however, that administrative rules on reindeer herding dictate when herders can move from one seasonal pasture to another. *Siidas* cannot move from autumn pasture areas to winter pasture areas before 1 November.

4.4.2 Skábma (*Period of Polar Nights*)

Skábma, the period of polar nights, follows from the middle or first half of November to sometime in the earlier part of January, around 45/46 till week 2. This period is characterised by snow on the ground (usually) and dark time (polar night) when darkness lasts for more than 24 h.

During this period, the reindeer are often found in boglands and low areas and dense forest terrains. This period usually has cold weather and no wind, so the forest will often have snow and ice on the trees (*rinádat*). *Ritni* is steam that freezes to ice-crystals on the ground. This happens when the temperature on the ground falls below the dew-point-temperature.³ *Ritni* was more common in earlier years when this period had longer periods *buolaš* (very low temperatures, i.e., below -10°C) (see Fig. 4.4).

In the last part of this period, due to climatic conditions, especially low temperatures, the herders will find granulated snow at the bottom of the snowpack (*seañáš*) that can last right until the beginning of April, possibly a period of almost 4 months with good grazing conditions. But the availability of pastures under the snow cover constitutes a critical bottleneck in the annual herding cycle. From around the end of November to the beginning of December the reindeer herd began to change behavior towards a *dálveallu* (winter herd).

Fig. 4.4 *Ritni* – steam that freezes to ice-crystals on the ground. (Photo: I.M.G. Eira)



³Dew-point temperature is the temperature below which the water vapor in a volume of air at a constant pressure will condense into liquid water. It is the temperature at which the air is saturated with moisture (see Jones MB (1985) Plant Microclimate. In: Coombs J, Hall DO, Long SP, Scurlock JMOBT (eds) Techniques in Bioproductivity and Photosynthesis, 2nd edn. Pergamon, pp. 26–40).

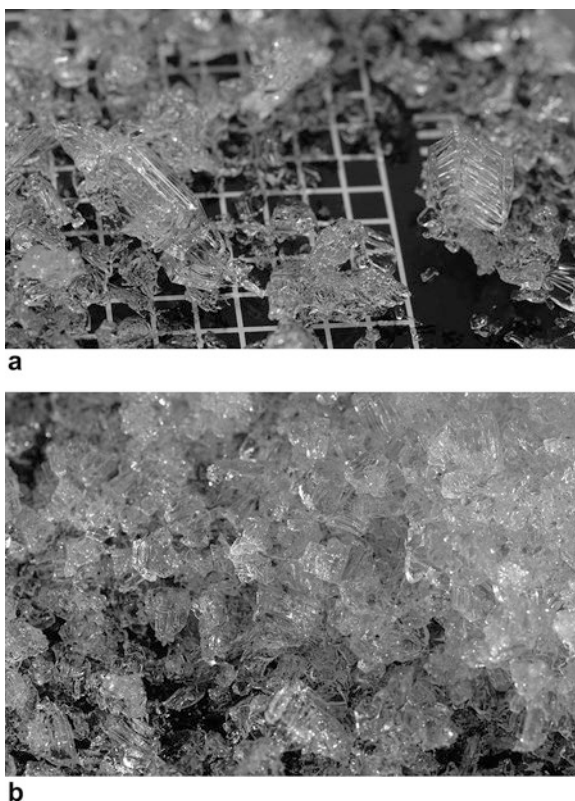
4.4.3 Dálvi (*Winter Period*)

The winter period begins in the middle/end of December, around week 50, and lasts till the beginning of February. In January the sun will be shining again in the north and the time of darkness is over.

These areas have been in permanent darkness for a few months when the sun remains below the horizon. The period is usually characterised with very cold, low air temperatures and snow. The coldest air temperature measured in Guovdageaidnu was -57°C (not officially recorded in the meteorological station) in January of 1999 (Eira, 2012). Cold temperatures are a prerequisite for the creation of loose snow, called depth hoar (*seahášš*) that is close to the ground which reindeer can easily dig through to access food (Eira et al., 2013) (see Fig. 4.5).

If the bottom of the snowpack is good (if there are loose snow types), then the reindeer easily can reach the vegetation underneath. But if there is ice at the bottom, this has a negative effect on their ability to graze. It is therefore important to check snow conditions at the bottom of the snowpack.

Fig. 4.5 (a) *Seahášš* – depth hoar. (Photo: I.M.G. Eira). (b) *Seahášš* – depth hoar. (Photo: I.M.G. Eira)



Examples from January and the beginning of February show herding decisions on winter pasture areas due to different snow conditions. Different topographical sections of the winter pasture are used, like *vuopmi* (woodland), *roavvi* (long, not very high wooded mountain), *čearru* (rather flat, usually wide tracts high up in the mountains with little vegetation and long stretches of nothing but gravel and stones) and *jeaggi* (marshes). In winter pasture areas reindeer herders also encounter terrains that are dangerous for both people and animals called *opmu* (miry holes) (see Fig. 4.6). Herders with local knowledge will know the location of these and be able to avoid them. Reindeer, however, may seek these as there are fresh herbs, *gord-dehat* (*Equisetum fluviatile*) and calcium available here.

From around December to April, the herders emphasise whether the snow is loose or hard in their evaluation and characterisation of winter pastures, deciding how the herd has grazed (Eira & Mathiesen, 2021). If there is *oppas* (see Table 4.6 for English translation and explanation of Sámi snow terms) then it is good, but if there is *čiegar* then the herd has to be moved to other parts of the grazing area. They use their knowledge of *oppas* and *čiegar* which are determining factors in explaining an evaluation of the survival and sustainability of reindeer (Eira et al., 2010). *Oppas* designates an untouched or untrodden area in winter where reindeer have not been grazing (Nielsen, 1979:178; Eira, 2012) and *čiegar* designates areas in winter where reindeer have been grazing intensively and where the snow is hard (Nielsen, 1979 I: 382; Eira, 2012). This implies that grazing snow conditions are good because the entire snowpack from the surface to the bottom includes snow types like *vahca*, *luotkkomuohhta* and *seajáš* (Eira et al., 2013). The main strategy in winter is to use *oppas* in an economical way to preserve and save it as a kind of food-capital through the winter, which can contribute to the survival of reindeer during the winter (Eira,

Fig. 4.6 *Opmu* – some kind of miry holes. (Photo: Aslak Anders I. Gaup, Guovdageaidnu, 2019)



Fig. 4.7 Čiegar and Oppas. (Photo: I.M.G. Eira, 2012)



2012). The ideal image in each winter *siida* area mostly contains *oppas* and somewhat less *čiegar* (see Fig. 4.7).

During the winter period, the herders must know how reindeer or herds affect the snow cover and how this in turn affects areas where reindeer are to graze. The herding strategy in winter is often that the herder drives around the herd and monitors how the herd is grazing. The reindeer herd is subject to controlled spreading (*lávdat*) within a forest area, at the same time as one is aware of not driving the scooter in the area. It is important to keep the area as untouched as possible regarding tracks etc. *Lávdat* is perhaps the only way to utilise the pastures sensibly (Eira & Mathiesen, 2021). If the herd is grazing quietly and keeping together, the herder will be looking for tracks of straying reindeer. If there are tracks crossing the circling tracks of the herder's snowmobile, the herder must find out where the reindeer have gone and bring them back to the herd; and if the herder observes that the herd is not grazing quietly and has escaped from the core winter grazing area, he must find the reason for this behavior (Eira, 2012). This has to do with the knowledge of *guohtun*, on how reindeer access food through the snowpack. The perfect *guohtun* contains loose snow (*luotkko muohta*) and granulated, loose snow (*seanǰáš*).

Including *seanǰáš* process that can improve snow conditions, weather and wind can both improve snow conditions, or worsen them (Eira, 2012). A lot of snow and wind can cause *čearga*. This snow condition does not usually create big problems for the reindeer to dig in the snow, but it can cause poorer grazing conditions. *Čearga* conditions affect the mobility of both reindeer and humans as it is easy to travel on this type of snow. Consequently, the herders need to be very careful not to lose individual reindeer to neighbouring herds.

Weather, wind, and snow conditions from autumn–winter 2019 to spring 2020 made a *goavvi* (hazard) year for reindeer and herders (see Johnsen et al., this volume, Chap. 3). According to meteorological data (Fig. 4.10), there was a combination of much precipitation in the form of snow combined with strong winds, and the snow was transformed into round crystals that make snow denser and harder and led to much *čearga*. The snowpack became very hard, with ice layers on the surface, and below that there were hard, thick layers of snow (*čearga*), and under this were

an ice layer 2–4 cm thick (*geardni*). At the bottom of the snowpack, there were almost no *seanáš*. Many *siidas* also reported ice frozen in soil and vegetation (*bodneskártá*). There was a very late snowmelt this spring.

A lot of rain, snow, and strong winds from December 2019 to January 2020 increased the hardness of the snowpack throughout winter and until the snow started melting. The highest wind speed in Guovdageaidnu was 12.3 m/s on December 28th and January 4th (see the Fig. 4.10 below) and this led to a lot of thick *čearga*. The snow depth from base to snow surface (*gassa muohta*) was also 97 cm in March. In a normal year, the snow depth is approximately 60 cm (see Fig. 4.8).

4.4.4 Dalveguovdil (Mid-Winter Period)

Dálveguovdil period (mid-winter period) is the period from the beginning of February till the end of March/beginning of April. For reindeer herders, this period will usually be a very stable herding period.

The period starts with *dálveguovdeltahkku* (mid-winter week). A day of significance in this period is *Gintalbeaivi* (candle day) on February 2, and the associated week (*Gintaltahkku*). There is a saying in reindeer herding that *gintalbeaivi* marks the middle of the winter, or that on *gintalbeaivi* “the back of the winter breaks”. This

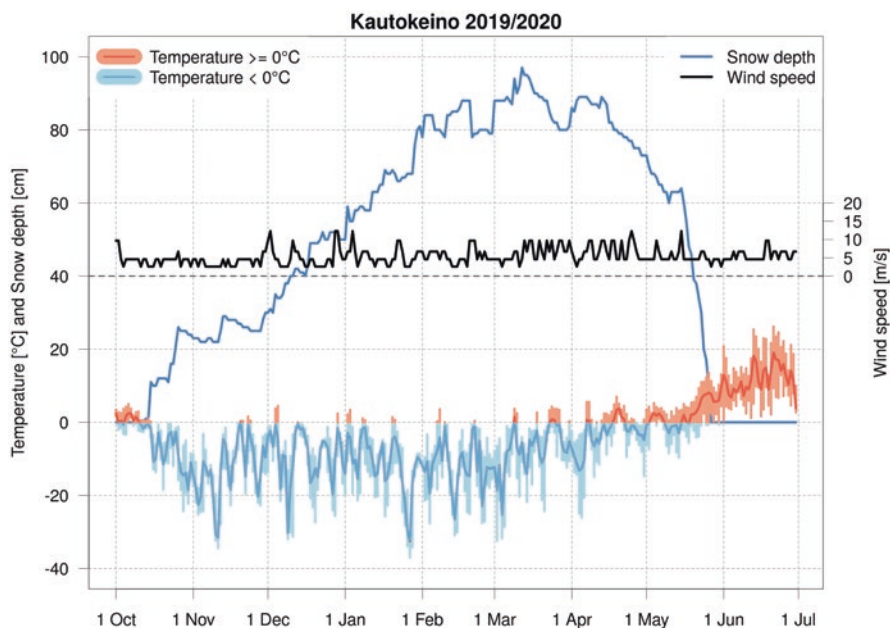


Fig. 4.8 Temperature, snow depth, and wind speed in Kautokeino from 1st October 2019 to 1st June 2020. (Julia Lutz, Meteorological Institute 2021)

means that from this day the weather begins to turn towards spring. Other days of significance are *Máhtebeaivi* (Mathis day) February 24th and *Márjjábeaivi* (Maria day) on March 25th. Reindeer herders have experienced that from *Máhtebeaivi* there will usually be more and more snow. This snow is often called *borgafásttut* (snow drift in time of fasting). *Fásttut* (time of fasting) follows Easter and will always fall on a Sunday 49 days (7 weeks) before the 1st day of Easter.

At the end of this period in normal years, the climate, higher temperatures, precipitation, and snow conditions will have a major impact on the reindeer and herding, and grazing conditions will be worse in the forest areas (*vuopmi*). The reindeer herd will thus move to higher topographical sections of the winter pasture, to tundra (*duottar*). This is the first time in the winter that the reindeer are moving. Thus, there is an alternation between two landscape or ecotype landscapes in relation to the snow (amount of snow, depth, hardness); *vuopmi* and *duottar* are two landscape types that are used in alternation.

If *guohtun* conditions earlier in the winter period have been good, and it has been possible to save area units where there is the least snow, e.g., larger openings in forests and marsh areas with low tufts, then the herd will still be able to stay in low forest areas (*vuopmi*). Thus, in the last part of this period, the reindeer herd will move to higher topographical sections of the winter pasture from woodland (*vuopmi*) to tundra (*duottar*). The weather type and snow conditions (amount of snow, depth, hardness) affect the alternation between the two landscapes.

4.4.5 *Gidda Period (Spring Period)*

The *Gidda* period lasts from the beginning of April to the end of May. In this period, the herd as a unit will change. At this time of year, the females will naturally separate from the males, but as a strategy it has been common for most *siidas* to make an orderly separation of males and yearlings that do not follow their mothers, to establish this part of the herd as a separate unit under supervision. After this, two different herds have been established – a female herd (*čoaŋŋjet eallu*) and a male herd (*luovas eallu*) – to be herded. In this period, the herders must use knowledge and skills to know which animals there are or not in the herd unit by getting an overview of the animals that have not been observed. This is a simplification, and a number of strategic animals are used to notice if these are present in the herd. Strategic animals often have special characteristics or special appearance (Eira, 1984).

The weather will change this period with increasing temperatures and melt and freeze cycles will appear, and the snow conditions and snowpack will change drastically (Maynard et al., 2011). In the period the temperatures will rise above freezing with melting snow or rain followed by refreezing (rain-on-snow conditions) form very dense ice layers in the snow. The strength in the snow layer increases with the number of melt-freeze cycles (*geardni, cuoŋu*). Weather conditions during the period of intense solar radiation make for warm days and thus the snow will become

wet and thaw (*njáhcu*), followed by strong refreezing during the cold nights. Refreezing of wet snow creates a melt-freeze crust on the surface (*cuoŋu*). The density and strength of the crust increases with the number of melt-freeze cycles. This is the *cuoŋu*-cycle (Eira & Mathiesen, 2021) (see Fig. 4.9).

In Guovdageaidnu, the temperature and snow conditions make this a challenging time, herds are grazing close to each other, so it is important to avoid mixing with the other herds. So, when herders say the situation is *cuoŋu*, the other herders immediately know that the snow is so hard that – in such conditions – the reindeer move quickly over great distances, and the herd must be managed tightly to avoid it running off or breaking up and scattering (Eira, 2011). (See Fig. 4.10).

When the situation becomes *cuoŋu*, the reindeer can enter the forest because they are no longer able to graze. The forest is important for the reindeer because they can find brown beard lichen (*lahpuid*) on the trees (Holand et al., 2000: 10; Eira, 2011).

While reindeer feed on many kinds of plant species on an annual basis, the main source of nutrition in the winter is various species of lichen (*jeagil*), but other plants like heather (*daŋas*) and grass (*sitnu*) are included in the menu. Access depends on snow quality and snow layers. Water intake is in the form of loose snow (*vahca*).

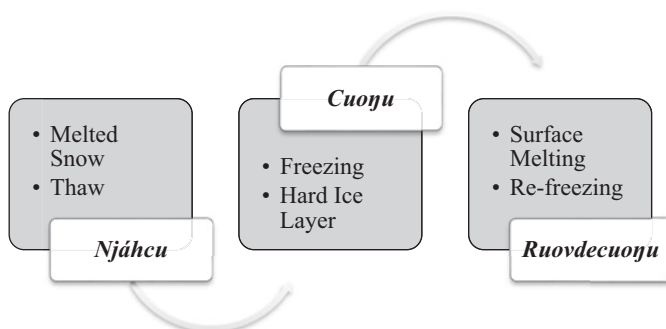


Fig. 4.9 *Cuoŋu* cycle

Fig. 4.10 Reindeer herders moving the herd. (Photo: I.M.G. Eira)



Space for physical activity (*lihadeapmi*) is essential. A reindeer is always on the move when it is not resting. Wind and landscape have a direct impact on the movements of a herd and its individual animals. Uphill and against the wind are the preferred directions for the movement of reindeer. Resting places (*livvasadji*) must be undisturbed and have shelter (*suodji*) when needed. Longer transfers for reindeer take place along a migration route (*johtolat*). Mobility for reindeer and herders (*siivu* ‘going’) depends on snow quantity and quality and on existing tracks on the snow, which in turn depend on wind conditions. There is a wide variety of terms designating different kinds of tracks. Observation of tracks is key to monitoring, controlling, and protecting a herd (*vuohittit* ‘find tracks of’), (*vuohádat* ‘the kind of snow (surface) on which animal’s tracks are easily seen’) (Nielsen, 1979 III: 828), (*časkilit* ‘look for tracks of animals’). Visibility (*oaidnin*) depends on daylight/moonlight, snow in the air, wind and snow conditions on the ground and rime on the trees, *ritni* (‘(thick) rime on trees’) (Nielsen, 1979 III: 276).

4.5 Discussion and Conclusions

This chapter has shown examples of which kind of knowledge the herders have about many aspects of their environment and their herds, and how they apply that knowledge throughout the snow-covered periods of the reindeer year. Our goal has been to outline reindeer herders’ own interpretation, perspective, and analysis of how herding happens throughout the year especially during the snow-covered parts of the year.

Our main findings show that there are many aspects of knowledge sectors Sámi herders are using as the basis for planning and decision making related to reindeer herding on snow-covered land. These are reindeer herders understanding and using multidisciplinary knowledge in a holistic approach to make decisions based on the reindeer’s needs and behavior in time and space. Reindeer herders’ indigenous knowledge is a prerequisite for working with reindeer and contains systematic, multidisciplinary, complex, holistic knowledge based in reindeer herding cosmology and professional language. The planning, decision-making and practices of herders are based on Sámi traditional reindeer herding knowledge. This includes knowledge about the different seasons, cycles, and periods in a *reindeer year*. As we have shown, this knowledge is complex, containing 8 seasons, diversity of daily or weekly cycles and even longer periods, and 9 herding periods.

Reindeer herding periods and cycles contain different sub-cycles that are a part of a larger system based on the year, the lunar month and day/night. In reindeer husbandry you will find, e.g., cycles related to the use of areas throughout the year; the biological cycles of reindeer, like rutting season (see also Skum et al., 2016), calving season, dropped or cast antlers and moulting fur (see also Collinder, 1984; Eira, 2011); sexual behavioral cycles; cycles relative to climate and snow, the cycles of sexual maturity, cycles of extreme years (*goavvi*) (see Eira, 2012) and cycles that include reindeer herding periods throughout the year.

It is crucial to have knowledge to be able to anticipate situations for reindeer based on weather conditions related to special weeks and days of the year that can provide information about what to expect. Herders' planning and decisions, and the practices of herding are based on the ability to anticipate situations and developments in near and more distant futures. The ability to anticipate or predict is based partly on a herder's experience and thus the knowledge and ability to observe (read nature) and calculate within a framework of the traditional knowledge foundations. Three factors are important for anticipating and adapting reindeer husbandry to changing environments. That is, the natural traits of reindeer, reindeer's utilisation of grazing (how grazing areas utilised throughout the day/night and any changes in grazing utilisation) and how climate change can conceivably impact changes in grazing plants, degree of utilisation etc. (Oskal et al., 2009).

Siida members' joint planning and decision-making is thus based on the ability to anticipate situations and developments in the near and slightly distant future. This ability to prognosticate is based on experience, knowledge, and the ability to observe (read nature) and calculate how to manage the herd within the framework of a traditional knowledge base. All these aspects of herding in winter include traditional observation and mental monitoring of variability and changes in time and space in the use of grazing land and grazing conditions (Eira et al., 2010). This can help herders anticipate reindeer movement by watching their natural behavior associated with the season, the pasture, and the area (Eira, 2011) in the annual cycle. The herds move between units of areas, which represent the best or only alternative in different seasonal sections. The major seasonal changes require predictability and rapid adaptation responses in reindeer husbandry (Paine, 1972). Furthermore, this includes knowing that herds have regular periods (over weeks), like typical gathering times and periods that are typical spreading times. The herder must anticipate situations and make plans and decisions according to the necessity of the reindeer and the herd.

Reindeer herders' multidisciplinary knowledge encompasses knowledge of individual animals, plants, landscapes, weather, people, and – not least – various kinds of interactions between them. Understanding the field of reindeer herding relies on various categories of thought, namely knowledge of reindeer, environment, landscape, weather, and specific knowledge of the mutual relations in these subjects, and characteristics, i.e., specific differences in reindeer, snow, and weather, and on landscapes. The core of reindeer herding traditional knowledge is centered on identifying and describing physical and biological characteristics and phenomena, considering the magnitude of the observed phenomena, considering the relationship between such phenomena, and predicting possible consequences. This knowledge is articulated and structured linguistically with categories that are passed on to future generations. and it includes subsystems linked to different types of science and knowledge such as hydrology, meteorology, biology, topography, animal welfare, land management, adaptation strategies to climatic conditions, etc. (Eira, 2022).

Reindeer herding knowledge is understood and structured holistically on domesticated reindeer and their relationship to humans, the relationship between animals and human beings, and the natural environment related to time and space.

The holistic way of knowing about reindeer herding requires comprehension of the parts: reindeer, environment, landscape, and weather are intimately interconnected and are explicable only by reference to the whole. In other words, everything is connected to something else, making it difficult to define something without referring to something else.

As we have seen, reindeer herding strategies and practices are highly complicated and systematic enterprises containing different types of knowledge on how the biological and gender-based behavioral aspects of reindeer and their movement in time and space are connected to climate, temperature, and snow metamorphism. According to traditional ways of understanding reindeer herding, often underlined by herders, herding strategies consist of continuous observation, judgment, and a combination of relevant factors in every situation. The ecological understanding of reindeer herding as a pastoral means of subsistence includes the variations of the seasons and the learned behavior by reindeer of migrating between and remaining in the same areas at different times of the year (Sara, 2001: 81; Eira et al., 2016). This is especially evident in the behavior patterns of individual animals and the herd, which can best be understood in terms of annual cycles, lunar months, and the day-and-night cycle.

However, the value of the knowledge varies according to the season of the year. At times, it is of little practical value and at others it is indispensable; in certain seasons, it is relatively difficult to regain lost knowledge (Paine, 1972). Based upon the traditional Indigenous knowledge of the land and land use over generations (and their practice of traditional reindeer husbandry) reindeer herders have developed important local adaptation strategies to live with uncertainties in their Arctic environment (Mathiesen et al., 2018). Without an understanding and knowledge of how the *reindeer year* breaks down, sustainable reindeer husbandry will be almost impossible to maintain in various areas as we know it from ancient times.

To enable the description of the complex understanding of herding periods based on Sámi traditional reindeer herding knowledge, the constellation of authors was important. This was facilitated by the constellation of the author team, with the expert reindeer herder and scientists. Without this it would not have been possible to collect and analyse concepts and terminology in reindeer herding needed to understand the herding periods. Reindeer herding narratives and language-based knowledge about themselves, and their tasks have been important inputs here to gain an understanding of their own reality of herding on snow-covered ground. As noted by Meløe (1997), we must experience something ourselves if we are to be able to understand the knowledge. What we understand the knowledge by are words, language or concepts that belong to the business. If you do not know the concepts of reindeer husbandry, then you do not know what the business contains.

Reindeer herding knowledge, like other types of traditional knowledge, has been given little attention by researchers and in environmental management. Most reindeer research has focused on biological aspects and measurable facts of individual animals like weights, blood values, parasites, metabolism etc. as mentioned before the reindeer herding knowledge represents a complexity of the system, as a holistic reindeer herding system. It is rare to see this complex knowledge in governmental

documents. Rather they try to simplify this complexity by making the complex “readable”. The complex applies to, for example, land use, business considerations, language, and concepts (Eira et al., 2016; Scott, 1998). Nevertheless, the knowledge and experience of the reindeer herders themselves is still the foundation for everyday management of herds, and this knowledge has not been replaced or superseded by research-based knowledge. Failure to incorporate Sámi reindeer herding knowledge in governance efforts will hinder adaptation to forthcoming challenges (see e.g., Turi, 2016).

With increasing climate change and land-use changes traditional reindeer herding knowledge is essential for forming reindeer herders’ adaptation strategies and building social ecological resilience. The preservation and use of such knowledge is therefore crucial for future sustainability of reindeer herding. Further research on indigenous reindeer herding knowledge on cycles and processes for herding and animal behavior can contribute to supporting reindeer herders’ adaptation strategies and highlighting opportunities and obstacles available. Further development and use of methodologies where indigenous traditional knowledge holders and scientists co-produce knowledge could be an important step towards this development.

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