Chapter 3
Adaptation to Change in Reindeer Husbandry in the Republic of Sakha (Yakutia), Russia

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Abstract With 170,000 domestic reindeer and 1295 reindeer herders, the Republic of Sakha (Yakutia) is a vital region for the reindeer herding economy. The Republic is the homeland of five Indigenous peoples that herd reindeer – Evenki, Even, Dolgan, Yukaghir, and Chukchi.

The paper looks at the history and characteristics of Yakutia's reindeer herding and herding peoples and analyzes the transformation of the traditional reindeer husbandry model into a collectivized industry from the 1930s. Loss of pastures, predators, and decline of traditional knowledge are affecting reindeer herders, with climate change exacerbating the problems. Another aim of the paper is to show the impact of climate change on the reindeer herding development through the example of four reindeer herding regions of Yakutia from the north to the south. In this regard, the article examines the climate change trends and, in a historical retrospective, the economic settings of this traditional nature management sector, which

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employs only the Indigenous peoples of the North. The identified climate change trends suggest that climate warming combined with other economic transformations has diverse effects on reindeer husbandry in the four districts under investigation.

The findings indicate that challenges such as loss to predators, loss of grazing land, and decline in traditional knowledge preservation affect herding communities already affected by climate change. The authors highlight the relevance of engaging Indigenous reindeer herding communities and their traditional knowledge in developing mechanisms for adaptation to climate change and predation. It is essential to support herders in their aspiration to decide their destiny and strengthen the family-based economy.

Keywords Reindeer herding · Collectivization · Poor weather conditions for reindeer herding · Predators · Traditional knowledge

3.1   Introduction

The Republic of Sakha (Yakutia) is located in the northeastern part of the Eurasian continent and is the largest region of the Russian Federation. The total area of the continental and insular territory of Yakutia, located in the basins of the rivers Lena, Yana, and Indigirka and the lower reaches of the Kolyma River, including the New Siberian Islands of the Arctic Ocean, is 3103.2 km^2, i.e., 1/6 of the territory of Russia. More than 40% of Yakutia lies north of the Arctic Circle. Yakutia stretches 2500 km north-south and 2000 km east-west. The average thickness of the frozen layer reaches 300–400 m and, in the Vilyuy river basin, even 1500 m. The territory of the Yakutia is the largest reserve of the Earth's biosphere, a global ecological reserve, and one of the climate regulators of the entire planet. Yakutia accounts for over 30% of the untouched nature of Russia and about 10% of the entire world (Popova et al., 2023). The territory of Yakutia is divided into four geographical zones: taiga forests (almost 80% of the area), tundra, forest tundra, and Arctic desert. The operational reserves of the Republic's forest resources are estimated at 10.3 billion cubic meters.

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Currently, the most pressing issues in the Yakutia herding industry are the disruptions of the snow cover, mining development, and predator population growth. The massive loss of reindeer due to predators exceeds the number of anomalies that the nomads can manage (Lavrillier & Gabyshev, 2018). This paper reviews the adaptive capacity in four reindeer herding regions in Yakutia (Fig. 3.1) using official statistical data and scientific literature.

Domesticated reindeer livestock is a vital resource for the traditional economy of the Indigenous peoples of the Russian Arctic. Klokov (2012, 2020) analyzed the variability of the reindeer population trends in different Arctic regions, the reasons why reindeer livestock increases in some areas and decreases in others, and how the population of domestic reindeer was affected by the collapse of the USSR. According to Golovnev et al., (2014), as cited by Klokov (2020), the dissolution of the Soviet Union caused a crisis in the social and political environment which Indigenous peoples had been adapting to for decades. In the crisis conditions, the peculiarities, which formerly would not be seen, played a decisive role: they helped some communities to overcome the crisis, while others were taken to the edge of catastrophe (Klokov, 2020).

3.2 The Homeland for Indigenous Peoples

Yakutia is home to five Indigenous reindeer herding peoples: Evenki, Even, Dolgan, Yukaghir, and Chukchi. Evenki and Even belong to the Tungus ethnolinguistic group, Dolgan is Turkic-speaking people, and Yukaghir forms an isolated language group.

In the north of the Republic, Yakut (Sakha) people also practice reindeer herding (Fig. 3.1). Reindeer husbandry in Yakutia covers a territory of 2.5 million km^2 which is about 83% of the total area of the Republic (Oskal et al., 2009: 71). This section is focused on describing traditional reindeer herding practices of Evenki, Even, Dolgan, Yukaghir, and Chukchi peoples engaged in different types of herding: taiga and tundra reindeer herding. The changes brought by the Soviet power and later periods will be addressed separately.

Evenki inhabit a vast territory from the coast of the Sea of Okhotsk in the east of Russia to the Yenisei in the west, from the Arctic Ocean in the north to the Baikal region and the Amur in the south. They are also settled in Northern China. Traditionally, the Evenki led a nomadic lifestyle engaging in traditional economic activities such as reindeer herding, hunting, and seasonal fishing. According to the 2010 census, the number of Evenki in Yakutia is 21,008 people, or 55.5% of all Evenki living in Russia (Neustroeva & Semenova, 2018). Evenki reindeer herding belongs to the taiga type: reindeer herds were small and used for transportation purposes – Evenki would ride the animals – and milking. Domestic reindeer are slaughtered for meat only if fishing, a seasonal activity, is unsuccessful or when the family faces hunger.

Even live in five regions of the Russian Federation: the Republic of Sakha (Yakutia), Khabarovsk Krai, Magadan Oblast, Kamchatka Krai, and Chukotka

Autonomous Okrug. In Russia, most Even live on the territory of Yakutia: 15,071 Even in 2010, or 67.3% of the total number of Even in Russia (Neustroeva & Semenova, 2018). The nomadic Even are reindeer herders and hunters, while fishing is secondary. Their reindeer herding belongs to the taiga mountain and tundra types. The Even used reindeer as transport for hunting and practiced riding and milking the animals. If hunting or fishing was unsuccessful, they slaughtered their reindeer for food. Their connection with the reindeer was very close, so the Even never killed them unless necessary.

Dolgan are nomadic Indigenous people. According to the 2010 census, 1906 Dolgan live in Yakutia, or 24.2% of all Dolgan in Russia (Neustroeva & Semenova, 2018). Their traditional occupations are reindeer herding, hunting, and fishing in some areas. The Dolgan lead a nomadic lifestyle without going beyond the forest tundra. Dolgan reindeer husbandry combines taiga-type reindeer herding and techniques of the Nenets sleigh herding. The Dolgan milked reindeer, used shepherd dogs, and hunted arctic foxes, geese, ducks, partridges, and wild reindeer.

Yukaghir inhabit three regions of the Russian Federation: the Republic of Sakha (Yakutia), Magadan Oblast, and Chukotka Autonomous Okrug. The Yukaghir are divided into two groups: tundra and taiga Yukaghir. According to the 2010 census, there were only 1603 Yukaghir in Russia – with 1281 people or 79.9% living in Yakutia (Neustroeva & Semenova, 2018). Traditionally, the Yukaghir have a nomadic and semi-nomadic lifestyle, which includes fishing and hunting. The tundra Yukaghir also herd reindeer, using them mainly for transportation.

Chukchi are the oldest inhabitants of the continental areas of the extreme northeast of Siberia, carriers of the intra-continental culture of wild reindeer hunting and fishing. The Chukchi are the smallest Indigenous group in the Republic of Sakha (Yakutia). According to the 2010 census, there were 670 Chukchi in the Republic, or 4.2% of all Chukchi living in Russia (Neustroeva & Semenova, 2018). The majority of Chukchi in Yakutia settle in the Nizhnekolymsky District – 506 people. Traditionally, coastal Chukchi hunt marine mammals, and inland Chukchi herd reindeer, their main source of subsistence, leading a nomadic lifestyle and using reindeer for transportation and meat.

Historically, there were two types of traditional economy in Yakutia: one based on reindeer herding and another one on sea mammal hunting. In the nineteenth century, the herd had from 3000–5000 to 10,000–12,000 animals. In the summer, the herders moved to the ocean coast or the mountains. With the onset of autumn, they moved inland to the forest borders for winter pastures, where they migrated between 5 and 10 km if necessary.

3.3   Important Reindeer Husbandry Region

With more than 170,000 reindeer, Yakutia is the area with the third largest number of reindeer in Russia. Today, 21 out of 34 municipal districts in the Republic are engaged in breeding domesticated reindeer (Table 3.1). In South Yakutia, taiga

reindeer husbandry is spread throughout the administrative districts of Aldansky, Olekminsky, Ust-Maysky, and Neryungrinsky. Mountain taiga reindeer husbandry occupies most of the Republic, and most of the reindeer here are bred and herded by the Even, such as in the Tomponsky District. Tundra and forest-tundra reindeer husbandry is practiced in the Arctic zone, where all five Yakutia's Indigenous peoples and Sakha people are involved in herding, and the northwest of Yakutia.

Today, 104 reindeer herding brigades employ 1295 people in Yakutia: brigadiers, herders, veterinarian reindeer herders, and workers in 21 districts (Official Portal of the State Assembly (Il Tumen) of the Republic of Sakha (Yakutia), 2021). These statistics do not aggregate data on the small number of personal subsidiary farms, but only the number of employees of officially registered legal entities. While the central part of the Republic no longer practices reindeer husbandry, the region has the potential for significant reindeer husbandry growth. There is a high diversity of reindeer breeds and sub-breeds in Yakutia. After the collapse of the Soviet Union and the transition to the market economy, reindeer husbandry in Yakutia deteriorated. Large reductions in domesticated reindeer were experienced (Fig. 3.2). In the 1990s alone, the number of reindeer fell by 2.5 times (Fig. 3.2). With a curtailment in breeding work, the rapid increase in predator populations as a control mechanism was halted. The economy weakened, and subsidies were reduced, topped by a reindeer slaughtering moratorium (Oskal et al., 2009). The moratorium on the commercial slaughtering of domesticated reindeer was lifted in 2005 (Dayanova et al., 2020). The reindeer livestock trends in different Russian Arctic regions depended on the number of reindeer in different institutional forms of reindeer husbandry (Klokov, 2020). The rapid growth of the livestock was observed only in the Nenets unregistered self-managing households in the West Siberian tundra, which were out of strict state control in the sphere of an informal economy. Another institutional form, reindeer herding enterprises, evolved in all other territories of reindeer husbandry in the Russian Arctic. It happened due to historical reasons, regional policies, and specific features of Indigenous communities' adaptation. The future of reindeer husbandry is determined mainly by state support (Klokov, 2020).

Reindeer herding constitutes the basis of the traditional economy and culture of many Indigenous peoples in Eurasia. By the beginning of the twentieth century, most Evenki, Even, Chukchi, Yukaghir, and Dolgan households had already become significantly diverse, albeit remaining subsistence. Transportation reindeer herding, a core activity, was supported by hunting, fishing, and collecting berries and plants. Some peoples focused on hunting wild reindeer and elk, while Chukchi were engaged in large-scale reindeer herding, their main source of subsistence. However, most Indigenous peoples in the North were involved in domestic reindeer herding, which was of great importance as transportation.

By the end of the nineteenth century, gold was mined in South Yakutia, and Evenki began to transport goods on reindeer (Maksimov et al., 2001). Aldan gold mining in South Yakutia led to the construction of the Amur–Yakutsk Road (AYaM) in the 1920s and Evenki worked for the transportation of goods and post, while hunting became of secondary importance (Rumyantcev, 2015). By the end of the 1920s, reindeer herders had to extra feed the reindeer involved in intensive

transportation of post; therefore, Evenki had to master a new type of labor – to harvest hay – while complementary feeding of reindeer with compound feed and salt was introduced after the Second World War (Rumyantcev, 2015). To our best knowledge, few reindeer were accounted for before the revolution. A sharp decrease in the reindeer population occurred over the early 1920s. Firstly, due to the First World War, when goods delivery was disturbed: there were no deliveries from 1918 to 1923, which led to the mass reindeer slaughter to feed the starving people. Secondly, the situation was aggravated by constant requisitioning and reindeer loss during the Civil War. The spread of necrobacillosis (*Fusobacterium necrophorum*) and icy ground led to mass reindeer mortality. Some pastures deteriorated during these years due to continuous grazing in the same place (Filippova et al., 2020: 178–179).

Collectivization in the northern territories began in 1927. It aimed at organizing supply, marketing, credit, and state financial assistance. Collectivization brought together consumption and production. In its initial stage, collectivization was voluntary and incentivized with loans and credit. In the beginning, only 15% of households undergo collectivization, mainly the poorest ones. The elimination of the prosperous households, known as *kulaks*, took place before, in 1930. By 1933, more than 80% of households were collectivized. After the expropriation, many herder families joined the *kolkhozes*, a form of a collective-owned enterprise (Kolesov, 1993). The establishment of the *kolkhoz* system brought immense changes. In some tundra areas, the emergence of large herds of domestic reindeer led to a reduction and then the disappearance of wild reindeer, which were the main hunting target for the Yukaghir and Even people. In the past, this would have inevitably resulted in starvation for the Indigenous communities. However, *kolkhozes* favored a shift from hunting to reindeer husbandry (Gogolev et al., 1975: 146). The authorities organized land and water allocation to secure the territories for *kolkhozes*. It resulted in the expropriation of the best pastures, hunting, and fishing lands from the *kulaks*. In 1931–1934, all these were assigned to *kolkhozes* (Postanovlenie VCIK, SNK RSFSR, 1930). As a result, during the 1930s, there was a widespread increase in the number of *kolkhoz*-owned reindeer. Reindeer numbers continued to increase even during the Second World War (1941–1945). In the post-war years, "*millionaire collective*[1]" *kolkhozes* emerged, in which the number of reindeer exceeded 10,000.

Reindeer husbandry technologies were changed, which led to fewer losses of reindeer. *Kolkhozes* used new grazing methods to tackle rapid pasture depletion, considering rotation grazing. Permanent corrals were built in the areas of the autumn slaughter and spring calving. As the economy of the *kolkhozes* strengthened, their facilities and equipment gradually improved. Later, the Soviet government launched a new round of social reforms in the 1950s. These reforms included the consolidation of agricultural enterprises, the removal of non-profitable settlements, and the relocation of the population to new villages. It had a detrimental effect on the life of the peoples of the North. *Kolkhozes* were merged and transformed into state-owned enterprises, or *sovkhozes*. The social conditions, living conditions, and production

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[1] A cooperative enterprise that makes millions in profits.

technologies in *sovkhozes* improved (Astahova et al., 2013). According to Khakhovskaya (2019) as cited by Klokov, "when the *kolkhozes* were reformed to *sovkhozes*, the reindeer became state property, and a new 'war' against reindeer herders started. The local authorities and the *sovkhozes*' administration tried to make them change traditional ways of reindeer pasturing and increase the *sovkhozes*' reindeer stock" (Klokov, 2020). From 1965 to 1968, land management aimed to increase the efficiency of pasture usage to benefit households. Reindeer husbandry innovations focused on enhancing meat production, which determined the herd structure with a predominance of the female population (Figs. 3.9a and 3.9b). However, this caused a setback in the traditional relationship between humans and reindeer. The reindeer were no longer a family member but a source of meat production. The herders started using rotation shift grazing: the brigade included two shift teams. One team was at the settlement, and the other was on round-the-clock duty with the herd. The reindeer were under constant supervision and control, which significantly increased herd survival. It also attracted more young people to reindeer husbandry, enabling them to spend quite a lot of time in the settlements. By the end of the 1970s, more than half of the reindeer herders were under 30 years of age. The shift method, however, replaced the family and clan organization of reindeer herding. The number of women in reindeer husbandry decreased dramatically, which also marked the disruption of the traditional nomadic way of life (Figs. 3.5a and 3.5b). Another innovation from the late 1970s was the slaughtering of yearlings for industrial meat production (Filippova et al., 2020: 187).

Since the 1990s, the number of reindeer and reindeer herders sharply decreased (Fig. 3.2 and Tables 3.4a, 3.4b and 3.5). Istomin (2020) discussed the diverse trajectories reindeer herding in Russia has taken in different areas of Russia after the collapse of the Soviet Union: (1) the northeastern/taiga trajectory, characterized by a collapse of Soviet-era state farms (*sovkhozes*) and a dramatic decrease of reindeer herding, and (2) the West Siberian trajectory, characterized by a collapse of *sovkhozes* and a boom in private reindeer herding. This diversity can be explained by three factors: the degree to which local reindeer herding has been "modernized" in the Soviet era, the legal status of the herders, and, most importantly, the worldview of "*sovkhoism*" as a complex of informal practices that manipulate collective property for personal advantage and communal security (Istomin, 2020).

3.4 Social and Economic Development of Neryungrinsky, Tomponsky, and Nizhnekolymsky Districts

Table 3.2 depicts the population scale of the Neryungrinsky District. In 1975, the industrial development of South Yakutia led to the foundation of the city of Neryungri. Before the Neryungrinsky region, the Timpton region was formed here in 1926 and abolished in 1963 (Rumyantsev, 2015). Today, the area of the municipal "Neryungrinsky District" is 98,800 km², which is comparable with an average

European country. According to the All-Russian Population Census of 2010, 1.6% of the population belongs to the Indigenous peoples of the North (in Yakutia −4.2%). The territory includes the city of Neryungri, six urban-type settlements, and two villages. The economy of the Neryungrinsky District is based on coal and gold mining industries and electricity generation. The Neryungrinsky District accounts for 20% of the total output of products and services in the Republic: 95% of the total coal produced in the Republic and over 30% of electricity (Investment Passport of Neryungri District). The region belongs to one of the most industrially developed regions of Yakutia and the entire Far East.

The population fluctuations in Tomponsky District are shown in Table 3.2. The decrease in the number of people is illustrated in Figs. 3.5a and 3.5b. The Tomponsky District was established on May 20, 1931, from four *naslegs*:[2] Tattinsky, Verkhoyansk, and two *naslegs* of the Oymyakonsky District. According to the All-Russian Population Census of 2010, 7.4% of the population belongs to the Indigenous peoples of the North. Today, the municipal district includes 2 urban-type settlements and 12 villages, united in 7 *naslegs*. Industrial production is developed in the region; coal and gold are mined.

The population scale of Nizhnekolymsky District is shown in Table 3.2. Nizhnekolymsky District was established in 1931. According to the All-Russian Population Census of 2010, 32.3% of the population belongs to the Indigenous peoples of the North. It includes the village of Chersky, a district center, and 11 other villages, united into 4 settlements. The district economy is based on reindeer herding: 12.2% of the Republic's reindeer livestock settles in this district.

Despite the different patterns of natural resource use in the represented regions of Yakutia, all of them have reindeer herding enterprises in common. In general, reindeer herding is practiced in 21 districts of Yakutia in diverse areas, tundra, forest tundra, mountain taiga, and taiga, i.e., in the areas inhabited by the Indigenous peoples of the North. Reindeer herding is a unique economic enterprise that employs only Indigenous peoples. At the same time, it also remains an Indigenous way of life.

3.5   Dangerous and Poor Weather Conditions for Reindeer Husbandry in Nizhnekolymsky, Neryungrinsky, and Tomponsky Districts (Between 2016 and 2020)

Biological diversity is the basis and an indicator of biosphere integrity (Kirpotin et al., 2021). Together with climate change, its loss is one of the two most essential planetary boundaries (Tonkopeeva et al., 2023; van Rooij et al., 2023). Current

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[2] *Nasleg* (Yakut *нэһилиэк*) is the smallest administrative unit in Sakha (Yakutia), a rural area/settlement with local self-government. From the time of the Russian Empire, the Yakut ulus (districts) were subdivided into *naslegs*.

changes in biodiversity in the vast landmass of Siberia are at an initial stage of inventory, even though the Siberian environment is experiencing rapid climate change, weather extremes, and a transformation of land use and management. Biodiversity changes affect traditional land use by Indigenous peoples (Kirpotin et al., 2021) and affect grazing conditions for reindeer (van Rooij et al., 2023). Mean air temperature in March, April, and May from 1960 has increased by more than 6 °C in Nizhnekolymsky compared to only 2 °C from 1966 in Tomponsky and more than 3 °C in Neryungri from 1920 until the present, showing variation in the territory of Yakutia (Figs. 3.3a, 3.3b, and 3.3c). These combined effects of an increase in spring temperature and biodiversity impact the economy of reindeer herders through "bad grazing years" (Table 3.3). Weather and climatic conditions are crucial factors in reindeer husbandry (Hanssen-Bauer et al., 2023). The seasonal weather conditions determine the features of grazing, the quality of feed, and the reindeer's health (Liskevich et al., 2018). According to the report of the World Economic Forum (WEF) in 2017, extreme weather events rank first in the top 5 global risks. Between 1990 and 2000, 150–200 hazardous events of weather were registered annually in the Russian Federation. Since 2007, the number of dangerous weather events has exceeded 400 per year (Roshydromet, 2017). According to the reindeer herders and environmentalists themselves, the weather hazards for reindeer husbandry are:

1. In winter (during the period of snow cover):

    (a) Ice crust on the surface of the snow, in its thickness, or on the surface of the soil. The formation of the crust usually occurs during the pre-winter period when temperatures are close to zero, with subsequent frosts that prevent its breakdown, and less frequently during winter thaws.
    (b) Severe and prolonged frosts.
    (c) Blizzards and severe snowstorms.
    (d) Very deep snow cover, making it difficult for reindeer to forage (Fig. 3.8a, 3.8b).

2. In spring (April–June):

    (a) Blizzards or blizzards during calving season (in domestic reindeer, this is the month of May).
    (b) Sharp temperature fluctuations during the first weeks of calf life.
    (c) Violation of the usual timing of spring, especially the melting of ice too early on the water barriers that reindeer herders have to cross during migration.

3. In summer (July and August):

    (a) Prolonged hot, dry, windless weather.

4. In fall:

(a) Disruption of the usual ice break timing due to the late onset of cold weather causes disruption in the normal rhythm of migrating and moving reindeer to winter or slaughter sites (Makeev et al., 2014).

However, warm winters in the tundra are much worse than cold ones, as thaws increase the risk of ice crust formation. And reindeer are adapted to cold temperatures because the thermoregulatory system is aimed at generating heat in the body. In summer, on the contrary, in hot weather, body thermoregulation works on "caloric extinguishing," which in critical conditions leads to the fact that reindeer stop feeding and stop accumulating fat reserves and reindeer simply cannot survive the next winter and bring healthy offspring (Klokov & Mikhailov, 2017). Therefore, in order to understand the dangers of dangerous years and bad weather conditions for reindeer husbandry, we learned the opinion of the reindeer herders themselves, who directly face the consequences of adverse weather events (Table 3.3).

According to the All-Russia Research Institute of Hydrometeorological Information, World Data Centre (RIHMI-WDC), in early November and December 2016 in Chersky, the daytime temperature rose to positive values (Nizhnekolymsky). On December 8, 2016, a strong increase in temperature by +22.3° per day (Tmin for December 7 was −18.3 °C, and Tmax for December 8 rose to +4.0 °C) occurred. There was rain, wet snow, and wind from the southeast of 4–9 m/s, with gusts of up to 11–16 m/s. On December 9, the daytime temperature was +1 °C. There fell 4 mm of rain, and at the same time, there was heavy snow with a snow depth of 42 cm. At the station Ambarchik Bay on December 8 and 9, 2016, the synoptic situation was as follows: light snow, snowstorm, a southerly wind of 10–15 m/s, gusts of up to 17–22 m/s, and maximum temperature of +4.2 °C. This synoptic situation was caused by the eastern process – the removal of warm air and a cyclone from the Sea of Okhotsk in a northwesterly direction. This process is characterized by temperature increases, snow, strong wind, and snowstorms in some places. The duration of the process is 3–4 days, while in neighboring areas and stations, the temperatures may stay as low as −40 °C and even below because of the stable influence of the Siberian anticyclone.

These synoptic conditions in December 2016 resulted in the formation of an ice crust, which made it difficult for reindeer to get food. According to the reindeer herders themselves, December 2016 was abnormally warm; the temperature rose to 0 °C and above, followed by a sharp cold spell, which led to the death of 500 reindeer. According to the Hydrometeorological Centre, in November 2016, the air temperature was 6–11 degrees above average, and the amount of precipitation was five times higher than the monthly norm (maximum snow height = 72 cm). In general, 2016 was a record-breaking year in terms of precipitation (398 mm) over the past 30 years (Hydrometeorological Centre of Russia, 2016).

There was a sharp decline in reindeer from January to May 2018 in the Nizhnekolymsky District. It was due to the icing of pastures and deep snow cover with icy infusions, which made it difficult for the animals to find food. As a result, 5316 reindeer died because of the natural catastrophe.

According to the Hydrometeorological Centre of Russia, during the period from January to April 2018, 14 cases of air temperature rise to 0 °C and above (abnormal weather in winter) were registered: 2 cases in January and 12 cases in April. On January 30–31, 2018, warming was caused by the removal of warm air from the south of China together with a cyclone through Kamchatka to Chukotka, Kolyma, and the Arctic coast. During the day in Chersky, the maximum temperature was +2.0 °C, with south wind of 3–8 m/s, little snow, and a snow depth of 79 cm. First strong winds and snowstorms were observed in Nizhnekolymsky District followed by abrupt warming, and the air temperature was 20–24 °C above average. Such sharp temperature fluctuations in winter lead to the compaction of snow cover and the formation of snow and ice crusts, which significantly complicates the extraction of snow fodder by reindeer. As a result, in Nizhnekolymsky District, more than 5000 reindeer (young animals) died over a 5-month period (from January to May 2018). In addition, the situation was complicated by the fact that fodder for domestic animals, including reindeer, was delivered too late because of the late opening of winter routes. As a result, the number of reindeer across the Republic decreased by 2.7% compared to December 2017 (Pavlova, 2018) (Figs. 3.8a and 3.8b).

The average annual temperature in 2017 reached a maximum, repeating the achievement of 2007 in the Neryungrinsky District (Chulman and Neryungri) (Table 3.3) (Roshydromet, 2017). There were anomalies in the annual average air temperature during the whole year: up to 1 °C in EPR (European part of Russia), up to −2 °C in Siberia and in the Far East, and + 3 °C to +5 °C in the Arctic regions, in the northeast of Yakutia, and in Chukotka (Hydrometeorological Centre of Russia, 2017; Popova et al., 2023). Autumn 2017 was also remembered for the fact that there was a lot of precipitation. The amount of precipitation was 2–3 times larger than average or even more. In the south of Yakutia, the amount of precipitation was 2–3 times higher, in Yakutia, at the end of October, and the amount of precipitation exceeded monthly norms (Hydrometeorological Centre of Russia, 2017). According to reindeer herders, the autumn of 2017 was remembered for the fact that the first snow fell late, and in some places, ice crusts formed on the pastures. According to the actual data for the Nagorny settlement, temperatures in October ranged from −12.1 to +4.5 °C, respectively; it rained until mid-October, and the first snow fell on October 19, with 4 mm of precipitation falling per 1 day. Due to temperature fluctuations and zero-crossings, the snow melted and formed a crust of ice, making it difficult for the reindeer to get food. During the month, the snow depth varied due to snow melting, and only in November a stable snow cover was established. In October–November 2017, the snow fell late and then melted; on some reindeer pastures, there was a crust in places where the snow did not melt (Kolesov: personal communication 2020). Also, in October, there was low drifting snow and snowstorms (12 cases in October), with gusts of wind of up to 10–15 m/s, which also complicated reindeer grazing and worsened the visibility – a prerequisite for herders to control their reindeer.

One of the adverse events in autumn is wet snow and rain, which is often observed in the south of Yakutia. On November 5 at Neryungri station, a rain shower was observed (RIHMI-WDC). The day or two before the onset of rain, the air

temperature at night dropped to −22.1 °C, the daytime temperature was −12.2 °C, there was little snow, and the weather was warm. Then, during the day, the temperature increased by +10 °C, there was a weak rain shower, the wind was 5–10 m/s from the south, and during the day, the temperature was −0.8 °C. This synoptic situation was caused by warm air from the south and Neryungri District was located in front of the cyclone. Rain in winter and an abrupt temperature rise contribute to the formation of rain crust on the snow, which, if thick enough, is dangerous for the reindeer. On the next day, November 6, the temperature dropped by 10 degrees, and there was heavy rain snow and wind with gusts of up to 10–15 m/s. In the following days, the temperature was within −10 to −15 °C, and then starting from November 15, there were frosts of −20 °C and lower (typical for November temperature). Also, for October–November at this station, 23 cases of gusty wind of up to 10–15 m/s, low-level snow drifting, and snowstorms were recorded.

In general, October and November are characterized by unstable weather, temperature changes, mixed precipitation (snow, wet snow), drifting snow, and blizzards, which are quite common. But rain in November is a rare phenomenon and is considered abnormal for this period.

3.6 Reindeer Husbandry Adaptation in Yakutia

In biology, adaptation refers to the process of adjusting behavior, physiology, or structure to become more suited to an environment. Johan Mathis Turi, the former Chair of the International Centre for Reindeer Husbandry (ICR) and President of the Association of World Reindeer Herders (WRH), stated that the concept of adaptation, rather than stability, is inherent in reindeer herding societies: We have some knowledge about how to live in a changing environment. The term "stability" is a foreign word in our language. Our search for adaptation strategies is not connected to "stability" in any form but is focused on constant adaptation to changing conditions (Mathiesen, 2023; Tonkopeeva et al., 2023). Massive loss of reindeer due to predators exceeds the number of anomalies that the nomads can manage and can be seen as maladaptation (Lavrillier & Gabyshev, 2018). In addition to the accumulation of climate change anomalies, economic crisis, industrial development (which also reduces nomadic space), and the absence of land rights (which complicates access to ancestral lands), the disaster provoked by predators reveals vulnerability (Lavrillier & Gabyshev, 2018). We can adapt to climate anomalies, industrial development, new illnesses, and economic crisis, but how can we protect our herd against predators (Lavrillier & Gabyshev, 2018)? Alexander Struchkov, Even reindeer herder from Tomponsky region, expressed in 2009: "Every herder has to adapt himself as you say adaptation, everyone has their method" (Oskal et al., 2009). Istomin and Dwyer (2010) suggested that as far as reindeer herding systems are concerned, animal behavior and the herders' actions can be best understood as being a product of a dynamic mutual adaptation (or the lack of) between animal behavioral patterns

and the herders' patterns of actions. They conclude: "dynamic adaptation results in shaping specific animal behavioral traits and human herding technologies that either lead to increased efficiency of a pastoralist system or lead to the destabilization of such systems and even their eventual collapse." Vassily Namchaivyn, Chukchi herder, expressed: "Remember, it is not us reindeer herders who have been the cause of climate change. The reindeer know what paths to take. Many people have lost their connection with Nature, but the animals maintain this connection and that is why we follow the reindeer" (Mathiesen et al., 2018).

One of the main threats to reindeer husbandry in Yakutia is predation. The main threat to the future existence of some of these Indigenous societies is the high population of bears, wolves, wolverines, lynxes, and eagles that prey on reindeer during the calving season (Figs. 3.4a and 3.4b). Over the past years, the number of wolves in Yakutia has remained at approximately 3500–4000 (Akimova, 2021). The Directorate of Biological Resources, Specially Protected Natural Areas and Natural Parks of Yakutia is no longer able to provide effective assistance to wolf control in the districts, and the number of reindeer loss to wolves is growing (Akimova, 2021). Russia did not ratify the Bern Convention for the protection of large predators yet but follows the convention in local management practice. Russia is an observer to this convention and could have allowed the regulation of predators via helicopter hunting. Spring is the reindeer calving season. Evenki reindeer herders in South Yakutia report that the loss of calves to bears can be as high as 50% in the first few weeks after calving. It is affecting reindeer herding communities all over Yakutia. According to the Ministry of Ecology, Nature Management, and Forestry of Yakutia, the total number of brown bears in 2017–2018 is estimated at 17,000 bears. The number of brown bears seems to increase due to the lack of recruited hunters, the high cost of the tax levy for issuing a permit to hunt brown bears, migration from neighboring regions due to fires, an improvement in the food supply, and a high birth rate (Ministry of Ecology, Nature Management, and Forestry of Yakutia, 2018). After bears are coming out of hibernation, the size of bears' stomachs is rather small, which makes them forage less than in autumn. For that very reason, bears mainly eat small reindeer calves after they are born and they do not hunt grown reindeer (Kolesov, personal conversation, 2021). Hunting for these predators is especially difficult in the mountainous and taiga regions of the Republic due to the landscape. As a consequence, the use of motor vehicles for transportation to hunting wolves is not particularly effective. "Wolf hunting in the taiga is completely different from hunting in the tundra, where you can use snowmobiles. Wolves are very difficult to get, so the control over their population should be carried out systematically involving the experience of herders, because we have the traditional methods of dealing with wolves, and we know a lot about their habits" (Pogodaev & Oskal, 2015).

Indigenous peoples hold ancient knowledge that was enacted in everyday life, developed over millennia, and transmitted through generations. This knowledge helped them thrive in the harshest conditions of tundra and taiga. It also reflects in the hunting skills of the Indigenous peoples of Yakutia and their knowledge about animals' behavior. For example, Evenki reindeer herders, whose main traditional

activity besides reindeer herding is also hunting, know what kind of reindeer bears would choose to chase and kill (Kolesov, personal conversation, 2021). Another example is about Yukaghir elders who remember that one should not hunt all the wolves that inhabit your area, because wolves will also protect "their" territory from wolves of a "stranger" territory, meaning they will not let other wolves hunt on your area (Shadrin, personal conversation, 2020).

Routine reindeer and household chores and hunting regulations prevent herders from the meaningful hunt for predators to protect the reindeer. Thus, it is necessary to cooperate and assist in controlling the number of predators to preserve the reindeer population and reindeer husbandry in the region. The appearance of wild dogs that attack reindeer also aggravates the current problem. The dogs arrived in the taiga with industrial shift workers. Quite often, when the shifts are over, laborers leave and abandon dogs that later stray into herds (Personal conversion with reindeer herders, 2020). Therefore, we recommend that mining and industrial enterprises impose strict rules for their employees for inappropriate treatment of personal animals. Reindeer herders in the taiga regions believe that shooting predators from helicopters and fencing off the calving pastures with an animal net can be more effective for controlling predators' numbers and protecting reindeer.

The Working Group II of the Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC AR 5 WG II) concluded that the protection of grazing land should be the most important adaptive strategy for reindeer herders under climate change (Larsen et al., 2014). The decreasing of pastures for wild and domestic reindeer is affected by an increase in the densities of predators on the remaining territories. The loss and degradation of reindeer pastures are often associated with oil and gas production, mining, and infrastructure development. Taiga reindeer herding areas in South Yakutia also face challenges: industrial development and loss of pastures (Figs. 3.6, 3.7a and 3.7b).

3.7   Conclusion

In reindeer husbandry, as in other sectors of the economy, weather conditions play a significant role, and if domestic reindeer are kept year-round, adverse weather conditions are observed in every season. Throughout the year on reindeer pastures, there are changes associated with the change of seasons but also rapid changes in weather conditions during the day or several days.

Unfavorable weather phenomena for reindeer herding are extremely low temperatures, high snow cover (height from 1 m and more), sharp warming (thaw) in winter, wet snow (during the calving period), rain (in winter), blizzards, and abnormal heat in summer. Such unfavorable weather conditions lead to different consequences, such as the death of reindeer, low business output, the death of young animals, and exhaustion from lack of food due to pasture endowment. Due to late autumn, as noted by reindeer herders, the "corallization" of reindeer and other work

sometimes takes place 1 month late, which also has a negative impact on reindeer herding.

Authors argue that the condition for the success of traditional reindeer husbandry is the informal economic environment. Peculiarities of the regional politics and adaptation of Indigenous communities affect the numbers of reindeer differently (Klokov, 2020). After the collapse of the Soviet Union, the development of reindeer herding took very different trajectories in different parts of Russia. The northeast Siberian and taiga direction is characterized by a dramatic decrease in reindeer herding. It went hand-in-hand with the collapse of post-*sovkhoz* collectives in the 1990s (Istomin, 2020). The number of reindeer has reduced in all regions, but the number of reindeer herders decreased more in the south (taiga) than in the north (tundra) (Fig. 3.2). Young reindeer herders in the taiga zone of South Yakutia must not be left behind and have equal support as those in the Arctic zone of Yakutia (Fig. 3.5b).

The large population of wolves (3500) and bears (14,000–17,000) as well as other predators such as lynxes, wolverines, and eagles in Yakutia became a challenge to reindeer herding communities. The industrial Soviet transformation of reindeer husbandry in Yakutia affected the Indigenous communities. The fact that traditional reindeer husbandry in South Yakutia still exists despite heavy industrial development in the region shows that Evenki reindeer herders can be resilient to changes. Yet, there are more challenges and changes, which means that it is necessary to enhance the resilience of the herding communities. There is a need for technical and financial assistance in the development of traditional livelihoods. Herders also have to resort to Indigenous knowledge of adaptation and resilience. The past 100 years of transforming reindeer husbandry and collectivization have affected traditional knowledge transfer from one generation to another. The original family-based system was gone after the Indigenous lifestyle became sedentary. Such a transition weakened the direct connection between practical experience and family life. It is an opportunity for them to observe and experience the nomadic way of life and participate in traditional practices.

Indigenous peoples hold ancient knowledge that was enacted in everyday life, developed over millennia, and transmitted through generations. This knowledge helped them thrive in the harshest conditions of tundra and taiga. It also reflects in the hunting skills of the Indigenous peoples of Yakutia and their knowledge about animals' behavior. Co-producing knowledge between Indigenous communities and scientists should aim for increased hunting efficiency, especially in the reindeer breeding season during the first weeks after calving to protect reindeer and Indigenous economies.

Adaptation to climate change requires long-term sustainable thinking training for local leaders within Indigenous and grassroots communities. This educational goal should reside on the best available adaptation knowledge. It is necessary to offer new means of delivering education to practitioners of traditional livelihoods, especially those in remote areas.

Appendices

Appendix 1: Figures

See Figs. 3.1, 3.2, 3.3a, 3.3b, 3.3c, 3.4a, 3.4b, 3.5a, 3.5b, 3.6, 3.7a, 3.7b, 3.8a, 3.8b, 3.9a, and 3.9b

Fig. 3.1 The Republic of Sakha (Yakutia) is located in the northeastern part of the Eurasian continent and is the largest region of the Russian Federation. With 170,000 domestic reindeer and 1200 reindeer herders, Yakutia is an important region for the economy of reindeer husbandry. While 30% of the Republic's territory belong to the protected areas of Russia, global warming and globalization affect the four regions investigated differently: Nizhnekolymsky, Tomponsky, Aldansky, and Neryungrinsky
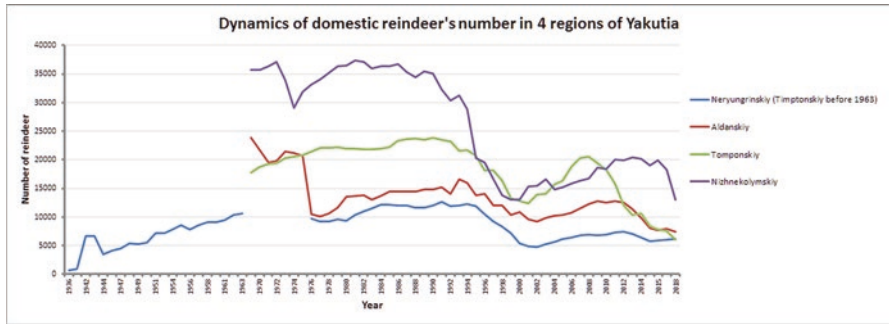
Fig. 3.2 Dynamics of domesticated reindeer population in Nizhnekolymsky, Tomponsky, and Aldansky districts in the period of 1969–2018 and Neryungrinsky District in the period of 1936–2018. Timptonsky District existed until 1963 and then became part of the Aldansky region. The Neryungrinsky District was created in 1976 after the city of Neryungri was founded in 1975. After the collapse of the Soviet Union and the transition to the market economy, reindeer husbandry in Yakutia deteriorated. Large reductions in domesticated reindeer were experienced. In the 1990s alone, the reindeer numbers dropped by 2.5 times (Official Statistics from the Government of the Republic of Sakha (Yakutia))
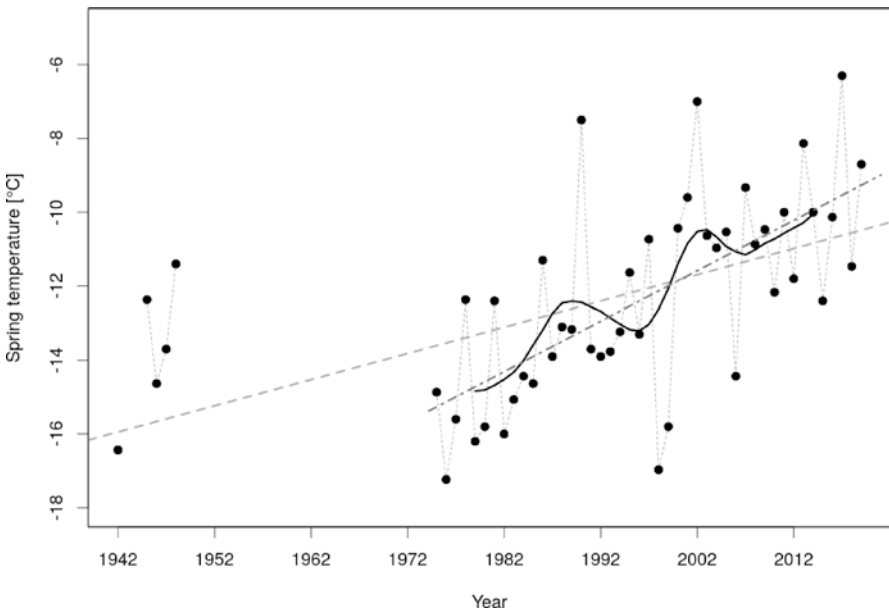

Fig. 3.3a Mean air temperature in March, April, and May in Nizhnekolymsky. From 1960, the mean air temperature has increased by more than 6 °C in Nizhnekolymsky compared to only 2 °C from 1966 in Tompo and more than 3 °C in Neryungri from 1920 until the present. The decrease in spring temperature and biodiversity impacts the economy of reindeer herders, what they refer to as "bad grazing years"

Fig. 3.3b Mean air temperature in March, April, and May in Tomponsky. From 1960, the mean air temperature has increased by more than 6 °C in Nizhnekolymsky compared to only 2 °C from 1966 in Tompo and more than 3 °C in Neryungri from 1920 until the present. The decrease in spring temperature and biodiversity impacts the economy of reindeer herders, what they refer to as "bad grazing years"
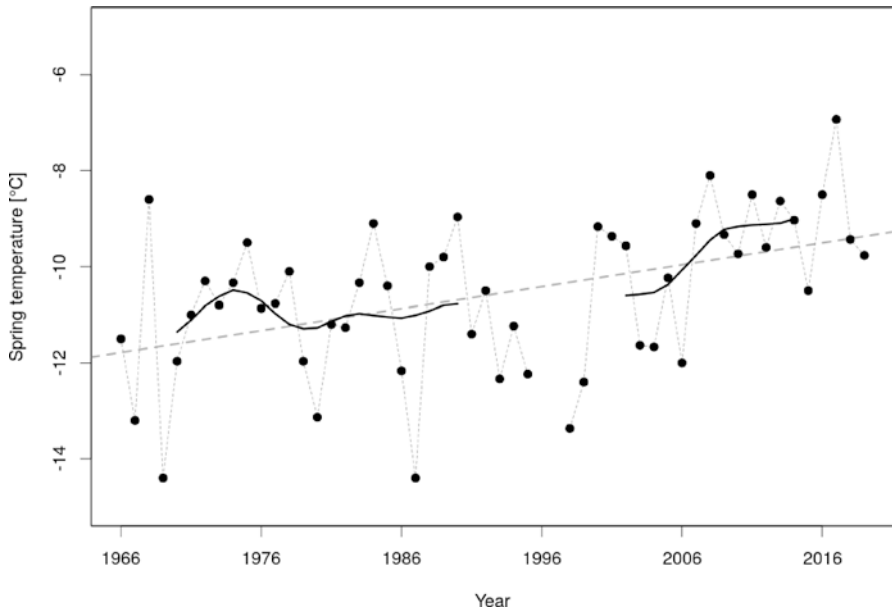

Fig. 3.3c Mean air temperature in March, April, and May in Neryungri. From 1960, the mean air temperature has increased by more than 6 °C in Nizhnekolymsky compared to only 2 °C from 1966 in Tompo and more than 3 °C in Neryungri from 1920 until the present. The decrease in spring temperature and biodiversity impacts the economy of reindeer herders, what they refer to as "bad grazing years"
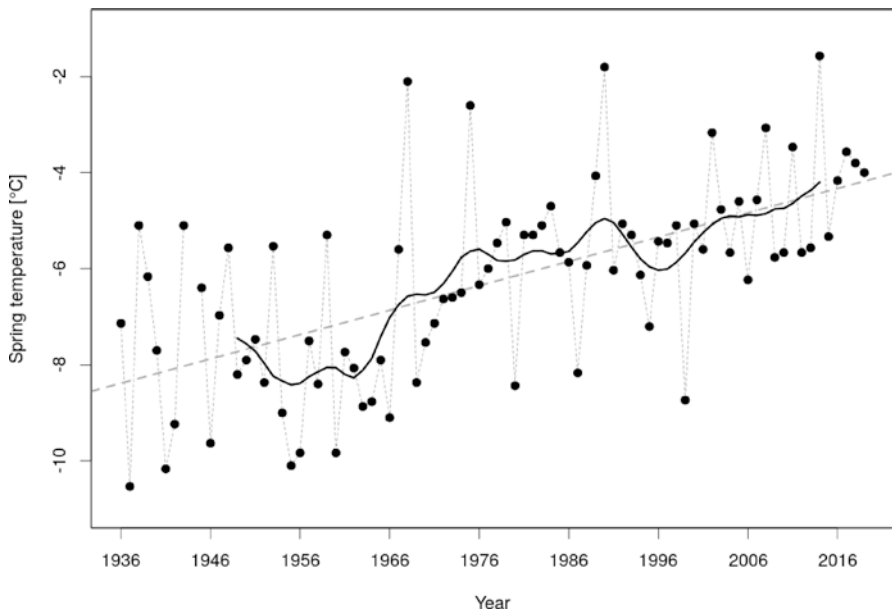
Fig. 3.4a One of the main threats to reindeer husbandry in Yakutia is predation. The main threat is the high population of bears and wolves that prey on reindeer during the calving season. Photo from the Neryungrinsky District (2018). (Photo: Igor Kolesov)

Fig. 3.4b Over the past years, the number of wolves in Yakutia has remained at 3500–4000. The total number of brown bears in 2017–2018 is estimated at 17,000 bears. Herders often found remains of reindeer eaten by predators. Photo from the Neryungrinsky District (2018). (Photo: Igor Kolesov)

Fig. 3.5a During the Soviet time, the shift method replaced the family and clan organization of reindeer herding. The number of women in reindeer husbandry decreased dramatically, which also marked a disruption of the traditional nomadic way of life. Neryungrinsky District (2018): Evenki reindeer herder Valentina collects spruce. Herders cover the ground in a tent with a thick layer of spruce in winter and with larch in summer. (Photo: Alena Gerasimova)

Fig. 3.5b Young reindeer herders in the taiga zone of South Yakutia must not be left behind and have equal support as those in the Arctic zone of Yakutia. The past 100 years of transforming reindeer husbandry and collectivization have affected traditional knowledge transfer from one generation to another. The original family-based system was gone after the Indigenous lifestyle became sedentary. Neryungrinsky District (2017): a young Evenki couple with their child. (Photo: Yuri Kokovin)

Fig. 3.6 Taiga reindeer herding areas in South Yakutia also face challenges: industrial development and loss of pastures. While the Republic of Sakha (Yakutia) has not yet experienced progress, like that in the Yamal region or along the Norwegian coast, there are substantial development plans on the table. Construction of the "Power of Siberia" gas pipeline. Neryungrinsky District. (Photo: Svein D. Mathiesen)

Fig. 3.7a Evenki reindeer walking nearby the gold mines. Aldansky District. (Photo: Svein D. Mathiesen)

Fig. 3.7b Evenki reindeer walking nearby the gold mines. Aldansky District. (Photo: Svein D. Mathiesen)

Fig. 3.8a Elena Antipina, Director of the Arctic College of the Peoples of the North in Chersky, stands on a narrow pathway cleared of snow. The photo illustrates the amount of snow in the north of Yakutia. Nizhnekolymsky District. (Photo: Elena Antipina)

Fig. 3.8b There was a sharp decline in reindeer between January and May 2018 in the Nizhnekolymsky District. Icing of pastures and deep snow cover with icy infusion made it difficult for the animals to find food. As a result, 5316 reindeer died because of the natural catastrophe. Chukchi reindeer herder points at ice crust in the layers of snow. Nizhnekolymsky District. (Photo: Elena Antipina)

Fig. 3.9a Soviet reindeer husbandry innovations focused on enhancing meat production, which determined the herd structure with a predominance of the female population. This caused a setback in the traditional relationship between humans and reindeer. The reindeer were no longer a family member but a source of meat production. Even reindeer in Tomponsky District. (Photo: Svein D. Mathiesen)

Fig. 3.9b Even reindeer in Tomponsky District. (Photo: Svein D. Mathiesen)

Appendix 2: Tables

See Tables 3.1, 3.2, 3.3, 3.4a, 3.4b, 3.5, 3.6

Table 3.1 The number of reindeer herders in Neryungrinsky, Aldansky, Tomponsky, and Nizhnekolymsky compared to other regions of the Republic of Sakha (Yakutia), Russia, according to the Territorial Body of the Federal State Statistics Service for the Sakha Republic (Yakutia)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total for the Republic of Sakha (Yakutia)	*2257*	*2157*	*2252*	*2183*	*1996*	*2060*	*2009*	*1842*	*1792*	*1490*
Abyisky	8	8	8	8	6	6	7	6	6	0
Aldansky	260	267	272	272	278	267	260	160	150	140
Allaikhovsky	20	20	17	10	15	21	6	0	0	0
Anabar	117	98	99	92	92	94	98	97	109	112
Bulunsky	148	133	154	144	147	140	115	129	163	150
Verkhnekolymsky	19	19	20	13	13	13	13	13	13	14
Verkhoyansk	81	74	86	90	57	45	40	48	48	22
Vilyuisky		3	4	3	3	4	3	3	3	0
Gorny	9	7	6	7	6	7	7	8	6	4
Zhigansky	130	111	130	110	76	68	76	75	76	75
Kobyaysky	149	148	145	123	143	155	118	130	93	83
Momsky	220	215	230	209	110	92	118	142	140	96
Nizhnekolymsky	169	172	182	195	140	219	216	162	162	112
Oymyakonsky	96	63	55	68	63	65	65	57	69	56
Olekminsky	78	14	74	97	92	88	117	111	116	71
Oleneksky	53	52	52	52	65	65	54	65	65	65
Srednekolymsky	26	61	56	57	49	38	40	37	28	28
Tomponsky	178	157	185	140	122	123	132	108	109	65
Ust-Maisky	13	17	13	13	10	9	6	5	9	9
Ust-Yansky	143	143	143	164	169	195	205	170	169	142
Eveno-Bytantaysky	182	208	152	160	170	181	157	109	128	135
Neryungrinsky	156	165	168	156	170	165	156	156	143	94
Yakutsk	2	2	1	0	0	0	0	0		

Table 3.2 The total population of the districts of Yakutia, Neryungrinsky, Nizhnekolymsky, and Tomponsky districts (per 1000), according to the Territorial Body of the Federal State Statistics Service for the Sakha Republic (Yakutia)

	1939	1959	1970	1979	1980	1989	1990	2000	2005	2010	2015	2020
Neryungrinsky[a]	7.2	9.4		57.5	66.6	120.2	119.9	93.1	89.4	82.8	77.1	73.9
Nizhnekolymsky	2,3	4.2	11.6	12.2	12.4	14.00	13.7	6,7	5.5	4.7	4.4	4,3
Tomponsky	0.8	10.0	13.2	18.1	18.8	23.00	22.7	16.3	15.2	14.1	13.5	12.5
Total population of Yakutia	413.8	487.4	666.7	851.8	876.0	1094.1	1111.5	962.5	953.2	958.5	956.9	971.9

[a]Formed in 1975, before that the size of the Timpton region was introduced (1926–1963), which between 1963 and 1975 was part of the Aldansky region

Table 3.3 Dangerous and poor meteorological conditions for reindeer over the past 5 years (from 2016 to 2020 in Nizhnekolymsky, Neryungrinsky, and Tomponsky districts)[a]

Date	Station/district	Meteorological conditions	Consequences
December 2016	Chersky/ Nizhnekolymsky	Abnormal weather conditions wet snow and rain	Reindeer mortality
October– November 2017	Chulman/ Neryungrinsky	Late snowfall, ice crust formation due to temperature changes; rain on November 5 in Neryungrinsky (RIHMI-WDC)	
January– May 2018	Chersky/ Nizhnekolymsky	Icing of pastures and deep snow cover (snow height in April to 1 meter)	Case and mass death from exhaustion (over 5316 heads) (Pavlova, 2018), low business output
October 2019	Kanku/ Neryungrinsky	October rainfall (RIHMI-WDC)	Reindeer corralling started a month late
October 2019	Aldansky and Olekminsky	Rainfall from October 1–3 (RIHMI-WDC)	Threat of reindeer exhaustion and mass death
Autumn 2020	Neryungrinsky	Late and warm autumn; marshes did not freeze and thawed under snow	Difficulty of reindeer movement
Winter 2020	Anabarsky	Lots of snow and warm winter	

[a]The table is based on the information given by the reindeer herders themselves for the years when it was unfavorable for reindeer husbandry

Table 3.4a Reindeer herd structure for Neryungrinsky, Aldansky, Nizhnekolymsky, and Tomponsky mean percentage and total reindeer in 1976 and 2018

District	Female %	Male %	Castrated %	Calves % in the herd January, 1	Calves % from females	Total quantity of reindeer (1976)	Total quantity of reindeer (2018)
Neryungrinsky (1976–2018)	45.2	16.2	16.1	19.9	43.8	9781	6204
Aldansky (1976–2018)	45.8	16.0	16.1	22.1	48.1	10,542	7366
Nizhnekolymsky (1976–2018)	51.7	15.3	5.4	27.5	53.5	33,211	13,094
Tomponsky (1976–2018)	50.2	13.5	10.2	26.1	52.3	21,484	6060
Mean for all	*48.2*	*15.2*	*11.9*	*23.9*	*49.4*	*–*	*–*

Table 3.4b Information for each region (%) for 1976 and 2018 highlighting the evolution in the composition of the herd in terms of females/castrated/males

District	Female %	Male %	Castrated %	Calves % in the herd	Calves % from females	Total reindeer number
1976						
Neryungrinsky	54.5	9.3	11.0	25.1	46.1	9781
Aldansky	47.5	12.0	16.2	24.3	51.1	10,542
Nizhnekolymsky	48.4	15.7	4.5	31.5	65.1	33,211
Tomponsky	49.8	9.4	7.2	33.7	67.7	21,484
Mean % in four districts	50.0	11.6	9.7	28.6	57.5	*75,018*
2018						
Neryungrinsky	38.2	14.0	31.2	16.6	43.4	6204
Aldansky	44.3	21.0	19.6	15.1	34.0	7366
Nizhnekolymsky	50.9	24.5	3.7	20.9	41.1	13,094
Tomponsky	51.9	17.0	16.1	15.1	29.1	6060
Mean % in four districts	46.3	19.1	17.6	16.9	36.9	*32,724*

Table 3.5 Characteristics and statistics of reindeer and reindeer herds in Neryungrinskynsky and Aldansky districts of the Republic of Sakha (Yakutia)

Taiga reindeer husbandry in Neryungrinsky and Timptonsky	Taiga reindeer husbandry in Aldansky
From 1981 to 1996, the number of reindeer in the Neryungrinsky District exceeded 10,000 reindeer The largest number of reindeer in the Neryungrinsky District was 12,632 reindeer in 1991 The smallest number of reindeer in the Neryungrinsky District was 4912 reindeer in 2001 A gradual decrease in the number of reindeer in the Neryungrinsky District has been noted since 1997 A sharp decline in the number of reindeer in the Neryungrinsky District occurred in 1999–2000, from 7129 to 5435 reindeer Female reindeer amount to 50% or more of all the reindeer in the herds (if we count all calves, females and males) in the Neryungrinsky District: in 1976, 54.5% (5331 reindeer); 1977, 50.6% (4667 reindeer); 1979, 50.1% (4801 reindeer); and 1980, 50% (4677 reindeer)	From 1969 to 1975, the largest number of reindeer was recorded, with more than 19,000 reindeer The largest reindeer population in the Aldansky District was 23,855 reindeer in 1969 The smallest number of reindeer in the Aldansky District was 7366 reindeer in 2018 A sharp decline in the number of reindeer in the Aldansky District occurred in 1975–1976 – from 20,645 to 10,542 reindeer. This is possibly due to the formation of the Neryungrinsky District and the transition of some farms to the new district From 2013 to present, there has been a gradual decrease in the number of reindeer Female reindeer in the amount of more than 50% of all the reindeer in herds (if we count all the calves, male and female) occurred only once, in 1997 (51% – 6143 reindeer). In other years, the number of females does not exceed 50% in the herd
The smallest percentage of female reindeer, 30.4%, of all reindeer in a herd (if we count all calves, females and males) (2008 reindeer) was noted in 1943 in Timpton District (which included Zolotinka and Chulman village sel'sovets; currently that area belongs to the Neryungrinsky District) If the herd is divided into males and females, then the highest percentage of the female reindeer can be found during 1970–1980, where females amounted to more than 60% During 2010–2018, the ratio of females to males was 45–50% If the herd is divided into males and females, then we can conclude that for 1969–2018, the number of females in the herd varies between 39% and 72%	The smallest percentage of female reindeer with 41.6% (4313 reindeer) of all reindeer in the herd (if we count all calves, females and males) was in 2005 If the herd is divided into males and females, for 1969–2018, we can conclude that the number of females in a herd ranged from 42% to 51% Since the 2000s, the ratio of females to males has been no more than 45%

Table 3.6 Characteristics and statistics of reindeer and reindeer herds in Nizhnekolymsky and Tomponsky districts of the Republic of Sakha (Yakutia)

Tundra reindeer husbandry in Nizhnekolymsky	Mountain taiga reindeer husbandry in Tomponsky
The largest number of reindeer was 37,336 reindeer in 1981	The largest number of reindeer was 23,892 in 1990
The smallest number of reindeer was 13,000 in 1999	The smallest number of reindeer was 6060 reindeer in 2018
A sharp decline in the number of reindeer occurred in 1990–1991 – from 35,138 to 32,246 reindeer	A sharp decline in the number of reindeer occurred in 1998–1999 – from 16,286 to 13,332 reindeer
Another particularly sharp decline in the number of reindeer occurred in 1994–1995 – from 28,796 to 20,320 reindeer	Since 2009, there is a constant decline in the number of reindeer
From 2004 to 2014, there was a gradual increase in the number of reindeer (from 14,808 to 20,130 reindeer)	During 1973–1995, the number of reindeer did not fall below 20,000
From 2017 to 2018, there was a sharp decline in the number of reindeer from 18,317 to 13,094	From 2001 to 2008, there is a gradual increase in the reindeer population (from 12,381 to 20,545 reindeer)
Female reindeer in the amount of more than 53.5% of all reindeer in herds (if we count all calves, females and males) was noted during 1980–1990	The smallest percentage of female reindeer with 43.4% (8358 reindeer) of all reindeer in the herd (if we count all calves, females and males) occurred in 1971
The smallest percentage of female reindeer in the amount of 45.7% (9207 reindeer) of all reindeer in the herd (if we count all calves, females and males) was in 2014	The highest percentage of female reindeer with 57.7% (7689 reindeer) of all reindeer in the herd (if we count all calves, females and males) occurred in 1999
If the herd is divided into males and females, for 1969–2018, we can conclude that the number of females in a herd ranged from 45% to 56%	If the herd is divided into males and females, for 1969–2018, we can conclude that the number of females in a herd ranged from 43% to 57%
Since the 2000s, the ratio of females to males has been no more than 45%	From 1993 to 2001, the number of females in herds varied within 51–57%

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