

Chapter 9

Reindeer Herding and Environmental Change in Reindeer Herding Regions of the Sakha Republic: Comparison with the Yamal-Nenets Autonomous District

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Abstract I investigated the influence of global warming or climate change on the indigenous peoples of Siberia, especially reindeer herders. Historically, despite problematic management systems (governmental, municipal, or private), these indigenous peoples have adapted to various natural and social changes. This chapter reports on field research into nomadic summer and winter camps in reindeer herding regions (specifically, the villages of Olenek and Sebyan-Kyuelj) of the Sakha Republic, with comparison to West-Siberian Yamal-Nenets reindeer herders. This was accomplished by direct interviews with herders and local administrative and enterprise executives. Some informants told of direct or indirect influences of meteorological change, but most were unaware of change in vegetation for reindeer forage or noted little influence of climate changes. I detected recent vegetation change around the herding camps for pasture conditions by examining normalized difference vegetation index (NDVI) images. Using this method even over short periods, one could detect certain anomalies of vegetation productivity. However, it was difficult to discern the meaning of such anomalies and verify their cause and effect. In future research into the influence of climatic change on the indigenous peoples of Siberia, we must consider its natural and social implications.

Keywords Reindeer herding • Climate change • Sakha • Yamal-Nenets • NDVI • Vulnerability

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9.1 Introduction

Russia has 1,583,000 domesticated reindeer, including about 194,900 (12% of all head in Russia) in the Sakha Republic and 683,300 (43%) in the Yamal-Nenets Autonomous District (at the beginning of 2012)¹. In Russia, there are 17 indigenous peoples of Siberia and the North who have been engaged in this traditional mode of subsistence, from Saame in the west of the continent and Chukchi in the east.

Reindeer herding in Russia has always been under pressure from political and socioeconomic changes and natural resource exploitation, and now global climate change through the twentieth century and into the twenty-first century. Moreover, reindeer herding has been affected by pasture conditions, which are dependent on the herding and husbandry method. In this context, agricultural collectivization is another important factor that has greatly affected reindeer herding, herders, and their societies.

The influence of climatic change on Siberian populations, including indigenous peoples, is not a new topic. Here, I briefly analyze the effects of vegetation and other environmental changes, including the normalized difference vegetation index (NDVI), on herding pastures in two reindeer regions of the Sakha Republic, specifically the villages of Sebyan-Kyuelj and Olenek.

9.2 Potential Influence of Climate Change on Reindeer Herding

In the twenty-first century there have already been several international projects dealing with far northern Eurasian indigenous peoples and their responses to the climate change. These projects have reported various results, including prospects for reindeer husbandry in the research regions. However, there has been insufficient research into East Siberian reindeer herding regions, including Sakha Republic.

Before introducing my field research in the Sakha Republic, I summarize what factors may influence reindeer herding, especially pasture conditions, based on previous research.

- **Anthropogenic changes:**
 - Natural (hydrocarbon, mineral, forest) resource exploitation
 - Industrial expansion and worker influx
 - Building infrastructure
 - Radioactivity (in certain locales)
- **Influence of reindeer herding**
 - Overgrazing and trampling of pasture vegetation
 - Fertilization of pastures from animal feces and urine

¹ Industry Program of Ministry of Agriculture of the Russian Federation Moscow 2013.

- **Climate change**

- Warming temperature
- Change in snow–freezing regime
- Change in freezing–thawing periods and frequency
- Change in precipitation amount and frequency

In addition, other phenomena that can be observed in various reindeer herding practices in Russia may be related to one or more of the aforementioned factors, such as

- Increase in reindeer predators (wolf, bear, and wolverine)
- Frequent insect harassment (e.g., mosquito and horsefly)
- Decline in reindeer populations

9.3 Field Research: Meteorological Data and Perception of Climate Change Among Reindeer Herders of Sakha Republic and Yamal-Nenets

In the framework of RIHN “Global Warming and the Human-Nature Dimension in Siberia,” I performed field research in two reindeer herding enterprises: GUP Sebyan based in Sebyan-Kyuelj village in the Kobyai District (2009) and MUP Oleneksky based in Olenek village in the Olenek district (summer 2010 and winter 2013). For comparison, I will introduce individual reindeer herding practices among Tundra-Nenets in the Yamal-Nenets Autonomous District of West Siberia, where I did field research from 1995 to 2008.

9.3.1 *GUP Sebyan*

Sebyan-Kyuelj is an isolated village in the Verkhoyansk ridge system of the north-eastern Kobyai District. This village has 800 residents, about 85% of whom are ethnically the Even people. There is a reindeer herding governmental enterprise called GUP Sebyan. It has 16,000 domesticated reindeer (including 5000 private reindeer) that are separated into 10 brigades (with multiple herds). I stayed at one summer camp of brigade No. 9, in the Sulanichan River valley (65°04'N, 129°53'E), about 1000 meters above sea level.

The grazing range of this brigade is small compared with other brigades. Vegetation around the summer camp at the end of August consists of sparse larch on hillsides and surface vegetation, mainly graminoid grass and lichen with mushrooms. The people of the brigade stay at a winter log house in the southern part of the grazing zone from December through March. In this camp and Sebyan-Kyuelj, I interviewed some Even residents and herders and collected the following information about climate change and perceptible phenomena as follows:

- **Climate situation**

- “Below average temperature in spring”

This does not correspond to JAMSTEC meteorological data offered by Mr. K. Yamamoto (Nagoya University) and K. Oshima (RHIN). According to their data, the spring (March–May) mean temperature from 1950 to 2008 has increased (Fig. 9.1).

- Repeated freeze-thaw cycles affect infant mortality of reindeer calves through the formation of ice crust over snow; this prevents reindeer, especially infants, from reaching forage under the snow cover.
- **River flooding and erosion** – Induced by heavy summer rains, the frequency and extremity of flooding has increased over the last 20–30 years; there is pasture degradation around the floodplain and riverbank erosion. Summer mean precipitation data show wide periodic amplitudes of annual temperature. Residents may perceive every positive anomaly as heavy rain.
- **Change of fauna**
 - Increase of wolves, bears, and wolverines, predators of domesticated reindeer. In mountainous taiga/tundra landscape, these animals attack more than one thousand domesticated reindeer every year. However, relationships between climate change and animal biomass, living place, and migration pattern are not clear.

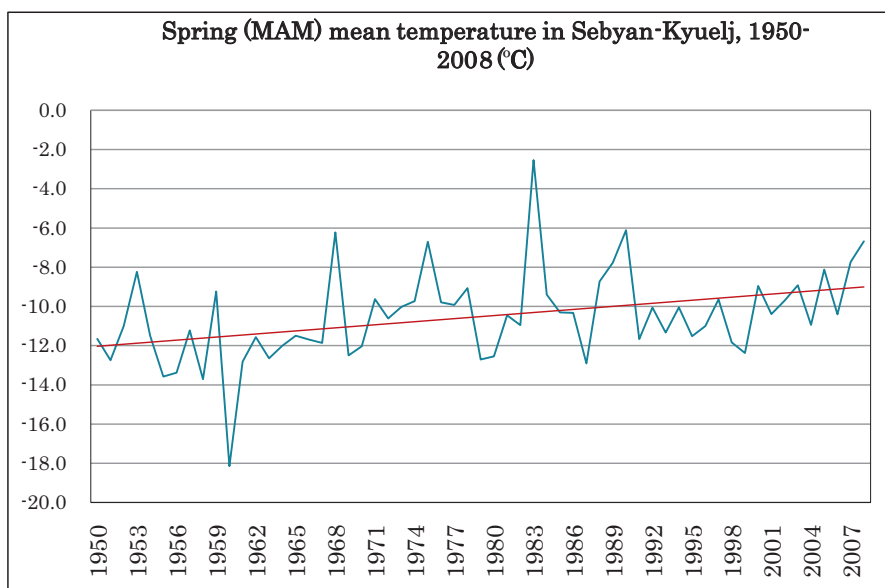


Fig. 9.1 Spring (MAM) mean temperature in Sebyan-Kyuelj, 1950–2008 (°C) (JAMSTEC BMDS by K.Yamamoto (Nagoya Univ.) & K.Oshima (JAMSTEC))

9.3.2 MUP Oleneksky

MUP Oleneksky is in the Olenek District of the northwestern Sakha Republic. Olenek is a central village on the left bank of Olenek River (68°30'15''N, 112°26'50''E). The main office of MUP Oleneksky is in Kharyyarakh village, on the right bank of Olenek River just across from Olenek village. The office was formerly Sovkhoz Oleneksky in the Soviet period. There were 3500 reindeer at the beginning of 2010, separated into three herds for each brigade. (For perspective, the greatest number of reindeer belonging to this enterprise was 34,000, in the 1980s). Reindeer graze during summer far from the village to the northwest, beyond the Sakha Republic and Krasnoyarsk Territory border. There is a treeline in the middle of the grazing range. Its southern part is mainly covered with larch forest, and the northern part is a mountainous tundra zone.

During my first visit, I stayed at six camps of three brigades (Nos. 1, 5 and 6). There, I performed field research in the northern part of the pastures, about 600–800 m above sea level, from the end of August to beginning of September 2010. I stayed at a camp 10 km north of the treeline (69°47'30''N, 109°28'58''E), although there was a sparse larch forest.

My second visit in winter camp in March 2013 was just during the time of gathering the brigade reindeer into the corral where the animals are counted and injections of anthrax vaccine are given. The corrals have been constructed near winter camps, where each herd stays for several weeks until the corral campaign or *koral-izatsiya* in early spring season every year.

The following is the result of herder interviews in the camps regarding the environmental situation.

- Climate situation
 - Temperature: *low temperature in summer and high temperature in winter* over the last 20–30 years (Figs. 9.2–9.4).

Some herders stated that “In summer, high-temperature spells used to last a week or so, after that they weakened. But last time there was no such continuous heat spell.

Using a short period of meteorological data, one can detect the same winter phenomena as indicated by the herders’ perception (Fig. 9.3).
 - Severe winter low temperature in 2012–2013. Such phenomena have occurred every 15–20 years or more during the last 50–60 years. However, winter (December–February) mean temperature from 1964 to 2013 indicates a slight rise (Fig. 9.4).
 - **Permanent snow cover** – Its area is diminishing. However, the influence of such a phenomenon is not clear.
 - **Precipitation** – Relatively heavy rainfall has increased in summer.

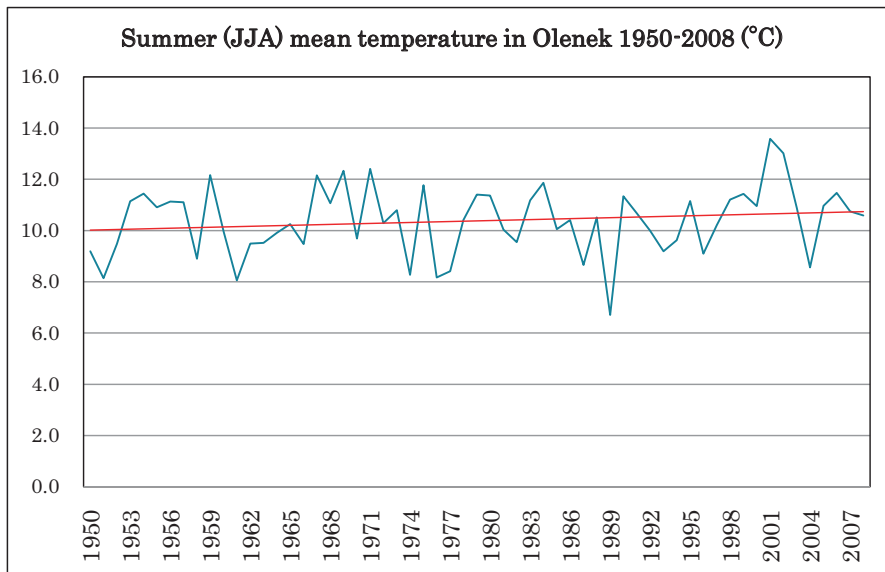


Fig. 9.2 Summer (JJA) mean temperature in Olenek 1950–2008 (°C) (Same resource as Fig. 9.1)

- **Change of flora**

- A northward and upward shift of the treeline. In the summer pasture of MUP Oleneksky in northwestern Olenek District, the open larch forest is shifting northward.
- When I asked one of the herders “What bothers you in this situation”?, he answered half-jokingly “It will take longer to pass through the forest zone, which means that it will take more time for us to get to the winter log house.”

- **Change of fauna**

- Wild reindeer migration routes changed in 1976 and since then, there have been frequent conflicts with domesticated herds. In autumn 2010, wild reindeer “abducted” 500 of 1200 domesticated reindeer in a herd of brigade No. 6; of those, only 200 head returned in winter
- The wolf population increase – In recent winters, this has become a serious problem for reindeer herding. It was discovered that in the Sakha Republic, there are an estimated 4000 wolves, and there has been a yearly increase by 500. There has been a concomitant increase in reindeer kills by wolves. From the beginning of 2013 through April, wolves killed more than 2600 reindeer. In winter 2012–2013, the Ministry of Agriculture of the republic offered a 20,000 ruble reward (700 U.S. Dollars) for killing a wolf.²

²Information from Internet site <http://www.ykt.ru/>, accessed 2013/3/14 and 2013/4/23.

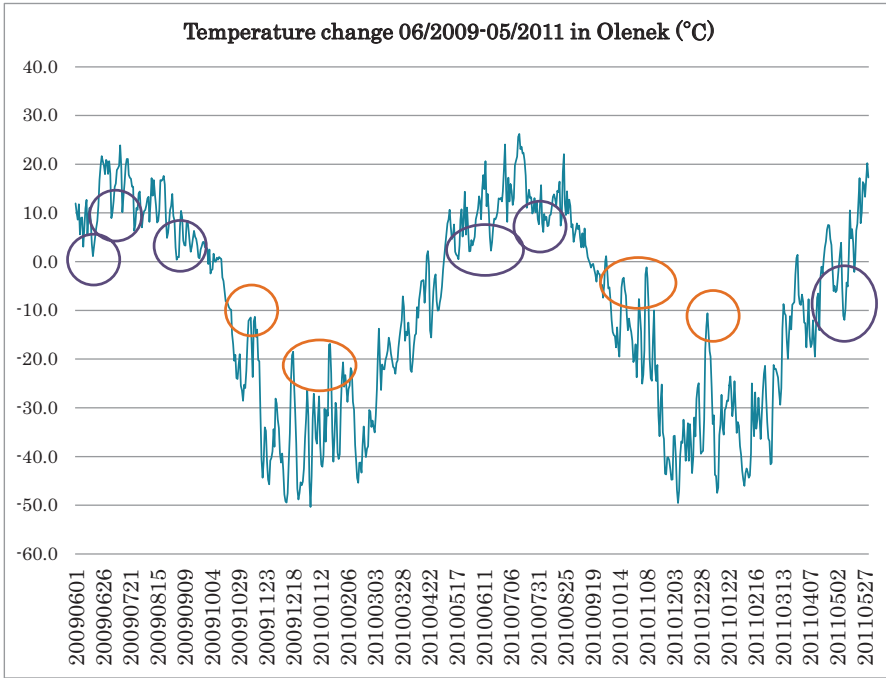


Fig. 9.3 Temperature change 06/2009–05/2011 in Olenek (°C) (Same resource as Fig. 9.1)

9.3.3 Tundra Nenets in Yamal-Nenets Autonomous District, West Siberia

For comparison, I now describe the West Siberian reindeer pasture condition and Tundra Nenets practice, based on published materials. In northern parts of the Yamal-Nenets Autonomous District (further: A.D.), “arctic tundra” or “dwarf shrub tundra” suitable for reindeer grazing are prevalent. A prominent feature of the District reindeer herding is that 53% of domesticated reindeer are privately owned. In contrast, in the Sakha Republic, this proportion is just 10%. In my study area (Tazovsky Region in Yamal-Nenets A.D.), the figure is about 80%. This contrast between Yamal-Nenets A.D. and the Sakha Republic is because of differences between methods of herding, husbandry, land use, and herding management. I will not give a detailed explanation of these aspects here.

There have been several research projects in the twenty-first century in this A.D. According to some of these works, pasture conditions are changing from comparatively stable to a more dynamic regime, as follows.

- **Temperature** – Summer air temperatures have increased around 2 °C over the past 25–30 years (Forbes and Stammler 2009).

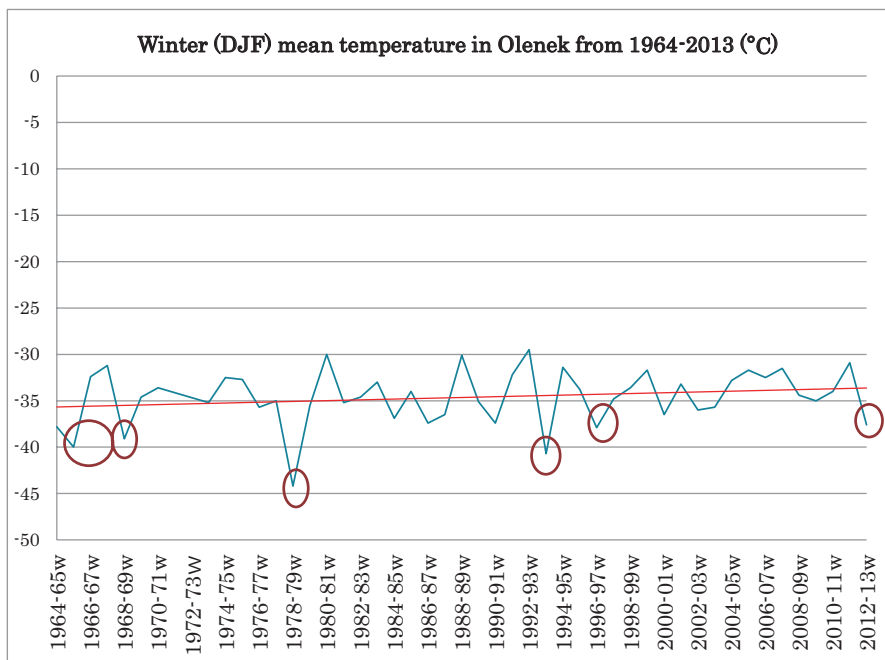


Fig. 9.4 Winter (DJF) mean temperature in Olenek from 1964 to 2013 (°C) (NOAA Satellite and Information Service)

- **Change of flora**

- There has been a northern shift of vegetation (shrub) (Goetz et al. 2011).
- There had been a transformation of shrub- to grass- and sedge-dominated tundra where intensive reindeer grazing is practiced (Forbes et al. 2009; Kumpula et al. 2011).
- De-lichenification has occurred (Bulgakova 2010).

- **Change of fauna**

- Populations of arctic fox, migratory birds (geese, ducks, swans), sea mammals, and fish (whitefish, family *Coregonidae*) have changed.

Except for arctic fox, which are hunted for fur, the above game animals and fowl are important local foods, especially for nomadic populations. The corresponding change of biomass might affect the food intake balance and thereby the dietetic situation of local populations.

9.4 NDVI Data Comparison of Reindeer Campsites in Sakha Republic and Yamal-Nenets A.D., 2000–2012

It is important to track the change of surface vegetation, which is the primary source of foraging for domesticated reindeer. Such change may be caused by climate change or herding activity (pasture usage). To detect surface vegetation productivity variation as affected by various factors in the aforementioned regions, I have investigated dates of maximum NDVI and presented them in color for visual understanding (Figs. 9.6, 9.7, 9.8, and 9.9). NDVI dates were provided by Dr. K. Yamamoto of Nagoya University.

9.4.1 Sakha Republic: Three Research Areas

The research areas are the same as above, summer and winter camp sites of MUP Oleneksky (see: Figs. 9.5-1 and 9.5-2 – summer and winter camp landscape). For comparison, I also analyzed wild reindeer river-crossing points across the Olenek River.



Fig. 9.5-1 Summer campsite of No.1 Brigade of the MUP “Oleneksky” (2010/8/28)



Fig. 9.5-2 Winter campsite of No.6 Brigade of the MUP “Oleneksky” (2013/2/28) ($69^{\circ}16'28.3''\text{N}$, $111^{\circ}16'53.5''\text{E}$)

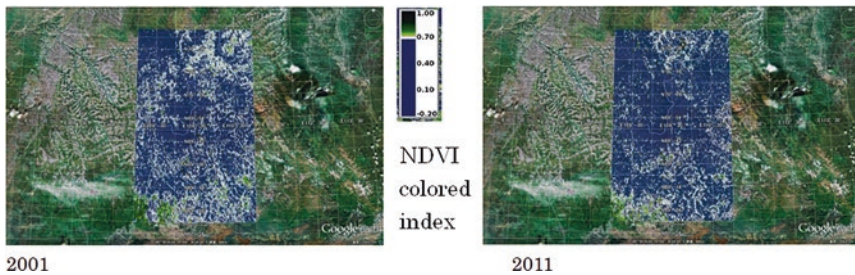


Fig. 9.6 NDVI value images of the pasture area of reindeer herds of the MUP “Oleneksky”

First, I detected change using comparatively small-scale satellite photos, with dimensions 100 km east–west and 150 km north–south. I detected some differences of change over 2000–2012, based on available maximum NDVI values. Two panels in Fig. 9.6 show Google Earth satellite photo insets of maximum NDVI from 2001 and 2011. Comparing the two images, overall it appears that values (green and white colored areas) were large in 2001 and small in 2011. At the image scale, it is difficult to distinguish domestic reindeer herding tracks, migration ranges, or campsite trampling. I therefore used larger-scale images for more detailed information on surface vegetation conditions.

9.4.1.1 Pasture Condition of MUP Oleneksky

Figure 9.7 shows maximum NDVI change at MUP Oleneksky No. 1 brigade’s two summer campsites during 2000 to 2011. Image insets at the center of the Google Earth satellite photos indicate three contrasting samples from 2001, 2004, and 2008. There was a minimum in 2004, maximum in 2008 and mean in 2001. Generally, the river basin area had large NDVI values, which are seen in the satellite photo (upper left), but the minimum of 2004 is evident, suggesting some meteorological influence in that year. Based on this analysis, in October 2012, I asked the director of MUP Oleneksky about pasture and weather conditions during 2004. The answer was as follows.

In autumn 2004, some specialists went to the camp for veterinary and zoological jobs and noticed unusual reindeer fatness. Summer weather that year was cold and rainy and plants did not grow well. The future forecast is for warmer winters and cold and rainy summers ...³

By comparing the NDVI information with that from the indigenous population about related areas, we can determine the level of agreement between these two sources regarding vegetable biomass change.

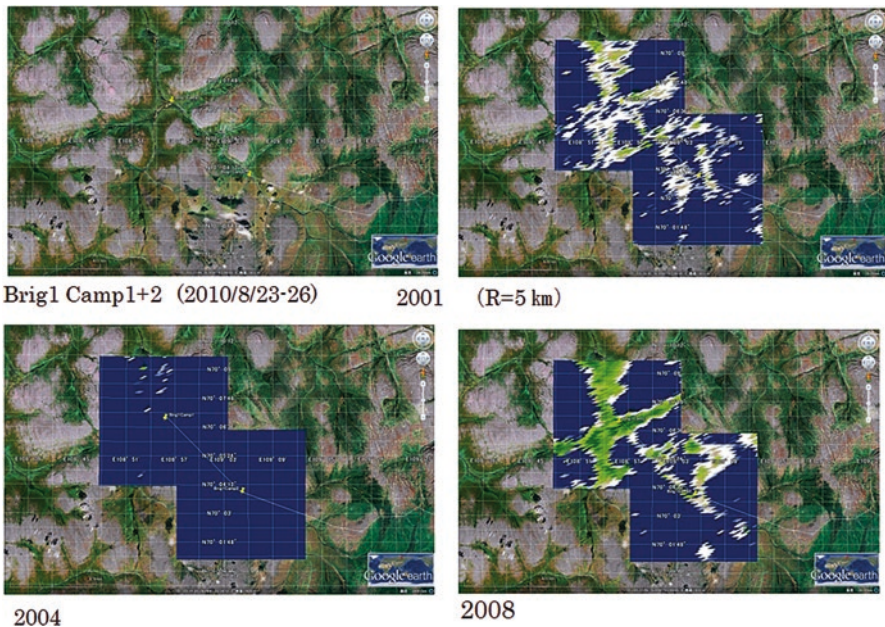


Fig. 9.7 NDVI value images of summer campsites Nos.1 & 2. of Brigades of the MUP “Oleneksky”. (Camp No.1: 70°6’51.51”N,108°55’38.076”E; Camp No.2: 70°3’47.76”N, 109°5’8.6159”E)

³E-mail from director of MUP Oleneksky, M. Kh. Nikolaeva, 29 October 2012.

For comparison, I show another case, that of winter pasture No. 6 brigade campsite of MUP Oleneksky ($68^{\circ}40'10.2''\text{N}$, $111^{\circ}40'16.6''\text{E}$). In this region, larch forest is also prevalent, mixed with rare Siberian spruce (*Picea obovata*). According to some herders, the lichen condition is not poor around the campsite. The maximum NDVI images do not appear to show change over the last decade as compared with northern summer pastures, although values from 2001 and 2004 are smaller than in 2008 (Fig. 9.8).

9.4.1.2 River Crossing Points of Wild Reindeer Across Olenek River

In the latter part of August along the middle of the Olenek River, one can observe river crossings of wild reindeer by a small herd or two or three individuals from the left (northwest) to right (southeast) bank, toward winter pastures. I observed such cases in various places. In the NDVI images, I examined an area around a campsite ($68^{\circ}26'55.00''\text{N}$, $114^{\circ}29'45.00''\text{E}$) for comparison with domesticated reindeer pastures. In comparison with northern tundra and forest tundra regions, values were large. There were no prominent changes detected over 2000–2011.

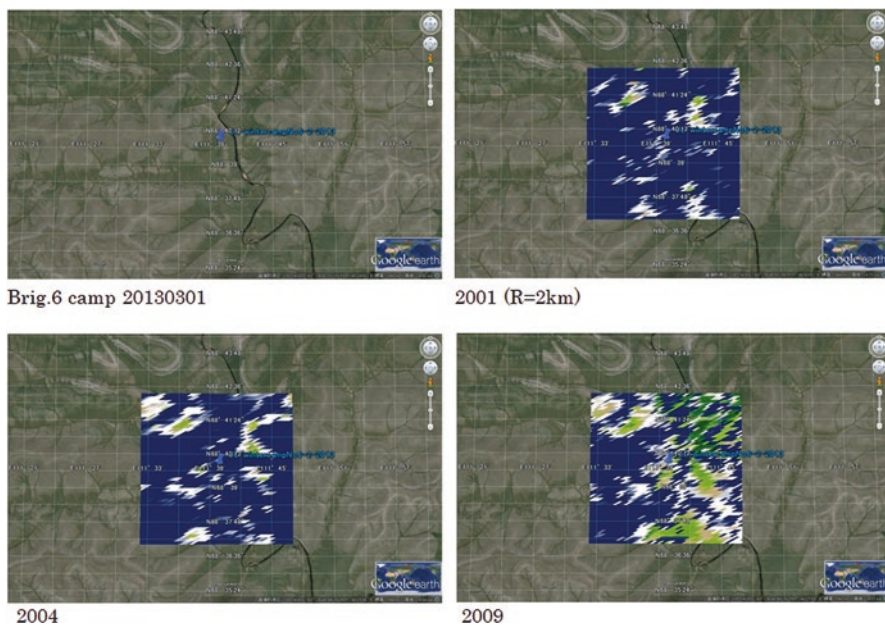


Fig. 9.8 NDVI value images of winter campsite No.6 of Brigade of the MUP “Oleneksky”. (Camp No.6: $68^{\circ}40'10.2''\text{N}$, $111^{\circ}40'16.6''\text{E}$)

9.4.2 *GUP Sebyan*

Here, I show a set of maximum NDVI images around a summer campsite of GUP Sebyan in the Verkhoyansk Mountains. The images shown in Fig. 9.9 indicate a difference between each image, i.e., small values (prevalent ultramarine area) in 2005 as compared with 2009 or 2011. However, the difference is not as pronounced as MUP Oleneksky’s summer pasture NDVI change, described above (Fig. 9.9).

During fieldwork at the aforesaid campsite, herders stated that the most serious problem was pasture erosion by frequent summer flooding and wolf (sometimes bear and wolverine) attacks on reindeer. Such incidents may be caused by climate change or anomalies, which the herders stated have become frequent over the last 20–30 years. These cases might be related to factors other than climate, but this should be analyzed further.

9.4.3 *Yamal-Nenets A.D.*

There have been research projects including NDVI analyses for Yamal Tundra Nenets. I summarize these based on one such work involving NDVI on the Yamal Peninsula in the western part of the A.D. The NDVI increased with warmer summer

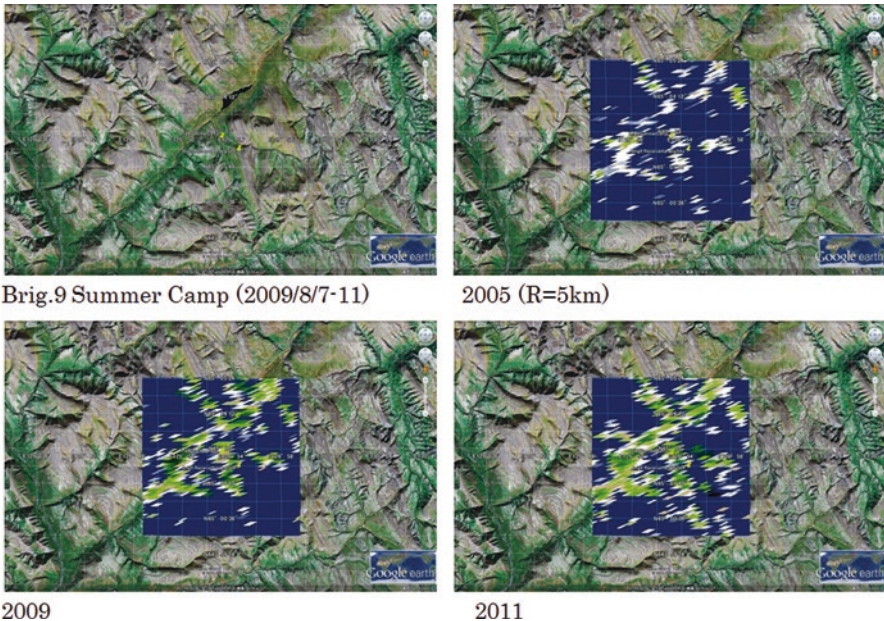


Fig. 9.9 NDVI value images in several years around summer campsite No.9 of Brigade of the GUP “Sebyan”, Kobyai District. (65°02’44”N, 129°53”E)

land-surface temperatures, but this relationship is not as strong as in the Arctic as a whole (Worker et al. 2011). I also examined NDVI imagery from 2000 to 2012 around pastures of the Gydan Peninsula, in the eastern A.D. There, I did fieldwork among Tundra Nenets reindeer herders from 1995 to 2005. However, like the examples of Sakha Republic pastures, the determination of situations surrounding anomalous surface vegetation change was uncertain. Therefore, the images used for analysis of Yamal-Nenets A.D. are not shown.

9.5 Analysis

Generally, the three reindeer regions in the Sakha Republic and Yamal-Nenets A.D. have both common and differing characteristics in the context of environmental change. Each region has its own unique features and problems, which depend on their ecological environment, tundra, mountainous tundra, mountainous taiga, socioeconomic situation, historical background, and ethnic or cultural aspects. One can distinguish the common aspects. From comparing natural and socioeconomic aspects of environmental change among reindeer herding in the regions, several features emerge, which are shown in Table 9.1.

Sakha reindeer herding areas, such as Sebyan-Kyuelyj (main ethnic group Even) and Olenek (Evenki) villages, will be socioeconomically vulnerable in the near future. This is because every governmental or municipal enterprise in the regions continue with unprofitable management, even with republic and federal subsidies.

Table 9.1 Natural and Socio-economic aspects of environmental change for the reindeer herders' communities in Sakha Republic and Yamal-Nenets Autonomous District

	Natural – meteorological/ biological – aspects	Socio-economic aspects
Common aspects	Temperature increase	Nomadic lifestyle
	Northward and upward shift of shrub vegetation or tree line	Local political autonomy (Y; So)
	Wild reindeer migration (S and Yg)	Local/Federal administration's support (affirmative action) – subsidy to entrepreneur, medical-hygiene services, boarding school system to nomadic populations
	NDVI anomalies during 2000–2012 years are detected (esp. So)	
Different aspects	Pasture condition – critical (Yy); warning (Yg); stable (S)	Prevailing public/collective (S) or private (Y) management of Reindeer herding
	Overgrazing(Y)	Non-profitable management (So)
	Pasture degradation by flood erosion (Ss)	Commercialization of products (in practice: Yy; experimental: S)
	Predator attack to domesticated reindeer (S)	Pasture degradation by oil and natural gas exploration (Y) Ethnic identity: strong and active (Y); weak and partly assimilating (So)

(Y Yamal-Nenets A.D., Yy Yamal Peninsula, Yg Gydan Peninsula, S Sakha Republic, Ss Sebyan-Kyuelyj village, So Olenek village)

Furthermore, the situation of wild reindeer migration has become critical for reindeer herding management in recent years. The problem of animal predation on domesticated animals has also become critical. Especially, in 2011 in the Sakha republic, there were about 13,000 reindeer kills by wolves. These phenomena are somewhat inevitable because the routes and periods of wild reindeer migration and predator habitats are unpredictable, and there are no effective methods of avoidance. In contrast, present pasture conditions do not appear critical, except for erosion caused by summer floods in mountainous taiga and tundra areas (mainly in eastern Sakha). Research in another reindeer herding region of Sakha (Tompo District) showed a similar situation of reindeer herder perception and pasture conditions (Nakada 2012).

In the Yamal (Tundra) Nenets case, the situation appears critical for pasture conditions, given the current resource exploration and industrial development. This situation is more serious in the western part of the region (Yamal Peninsula) and less serious in the east (Gydan Peninsula), though in the latter, a natural gas exploration project is in progress. Fortunately, the strong ethnicity of the Nenets people may help maintain their traditional subsistence system based on traditional ecological knowledge (TEK) or local knowledge (LK).

Maximum NDVI image analysis showed that certain vegetation changes or anomalies have occurred in a relatively short period (2000–2012). However, it is unclear as to whether these phenomena are a direct result of global climate change or regional or periodic anomalies. One can only say that there have been some anomalies in this extreme northern environment, which affect subsistence activities of indigenous peoples in Siberia.

9.6 Conclusions: Nomadic Reindeer Peoples' Vulnerability Under Climate Change

Pastoralism and nomadic lifestyles are highly resilient means of subsistence. These permit nomadic peoples to move not only for their domestic animals but also to avoid natural or environmental difficulties, or occasional social conflicts. Of course, the mobile lifestyle of reindeer herding must be based on the existence of vast regular pastures. In this context, it is important to investigate and analyze pasture conditions and their use from various aspects, including TEK or LK. This will be done in our future research.

In analyzing the vulnerability of nomadic reindeer peoples, it is important to consider not only natural but socioeconomic characteristics. We know that as a type of nomadic pastoralism, reindeer herding is a highly adaptive subsistence system. Moreover, this herding is a very profitable sector of the economy in the far north. A Russian expert indicated that full-year pasture maintenance for reindeer obtained as much as seven rubles of income per one ruble cost of herding

(Podkorytov et al. 2004). This is likely one of the major factors for the existence of reindeer herding throughout the centuries in Northern Eurasia.

We lack sufficient understanding of how societies build adaptive capacity in the face of change (Crate and Nuttall 2009). Therefore, it will be important to examine several approaches to current and future vulnerability studies. To integrate traditional and scientific knowledge, it will be vital to consider and emphasize the social dimensions of climate change (Huntington et al. 2004; Ishii 2011; Stammler-Grossmann 2010).

Acknowledgments I greatly appreciate the assistance of Dr. K. Yamamoto, Nagoya University for providing NDVI images of various regions in Siberia. I also deeply thank the herders and administrative executives of Sebyan-Kyuelj and Olenek villages for advice and support to this research.

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