

# REPORT

## THE EFFECTS OF CLIMATE CHANGE ON HUNTING AND REINDEER HERDING PRACTICES AMONG THE TOZHU OF SOUTHERN SIBERIA

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### ABSTRACT

The effects of climate change on reindeer herding and human communities relying on it have been well-documented in the circumpolar North. By contrast, very little attention has been paid to the degree to which climate change has affected the mixed economy of southern Siberian native communities. This report describes the observations and experiences of climate change made in recent years by Tozhu herder-hunters in southern Siberia. Among the Tozhu, climate change is not necessarily seen as a serious threat compared to economic and social issues. However, the effects of climate change, including hotter, rainier summers, weather unpredictability, and increasing numbers of predators and parasites, have been observed since the mid-2000s and put additional pressure on Tozhu hunting and reindeer herding.

The Tozhu live in the northeastern part of the Tyva Republic, located in southern Siberia not far from the Mongolian border (Fig. 1). They are the only group who practice reindeer herding in Tyva. Tozhu people, however, are also known in the anthropological literature as “territorial hunters” (Khazanov and Schlee 2012:12) who practice reindeer herding “as a secondary activity that facilitate[s] the principal economic and productive activity of hunting” (Donahoe 2012:100). In other words, they are best described as “hunters with reindeer” (Andreeva and Leksin 1999:92).

Tozhu people are a subgroup of the Tyva and have been recognized as an “indigenous small-numbered people of the North, Siberia, and the Far East” by the Russian government since 1993. According to the 2010 census, their population is 1,858 (Federal'naya Sluzhba Gosudarstvennoi Statistiki 2010). They speak Tyvan, a Turkic language and the second official language of the Republic of Tyva after Russian. The Tozhu have a long history of reindeer herding and a deep understanding of their natural environment. They have lived for thou-

sands of years as nomadic or seminomadic “herders and hunters” (*olenevody i okhotniki*) in the mountainous taiga (boreal forest) of the Academic Obruchev Range, in the western fringes of the mountains (Fig. 2).

In *Rangifer* typology, Tozhu reindeer are classified as forest reindeer or *Rangifer tarandus valentinae* (Flerov 1952; Ingold 1980; Klokov and Krushchev 2004; Mukhachev 1976). Forest reindeer are the largest and tamest among all species of domestic reindeer (Kertselli 1925). Known today as the Tofalar breed (Baskin 2009), these animals were once referred to as the Karagas breed (Petri 1928). Anthropological research suggests that reindeer were first domesticated in Central Eurasia, more particularly in the Sayan Mountains on the border between Siberia and Mongolia (e.g., Vitebsky 2005). In the mixed taiga-tundra environment of southern Siberia, the Tozhu have developed the so-called Sayan- or taiga-type of reindeer herding, which a number of scholars recognize as the oldest form of reindeer herding (Kyzlasov 1952; Laufer 1917; Mänchen-Helfen [1931] 1992; Vainshtein 1961, 1971, 1980). Distinct features of Sayan reindeer herding include small herds,



Figure 1. The Republic of Tyva in the Russian Federation.

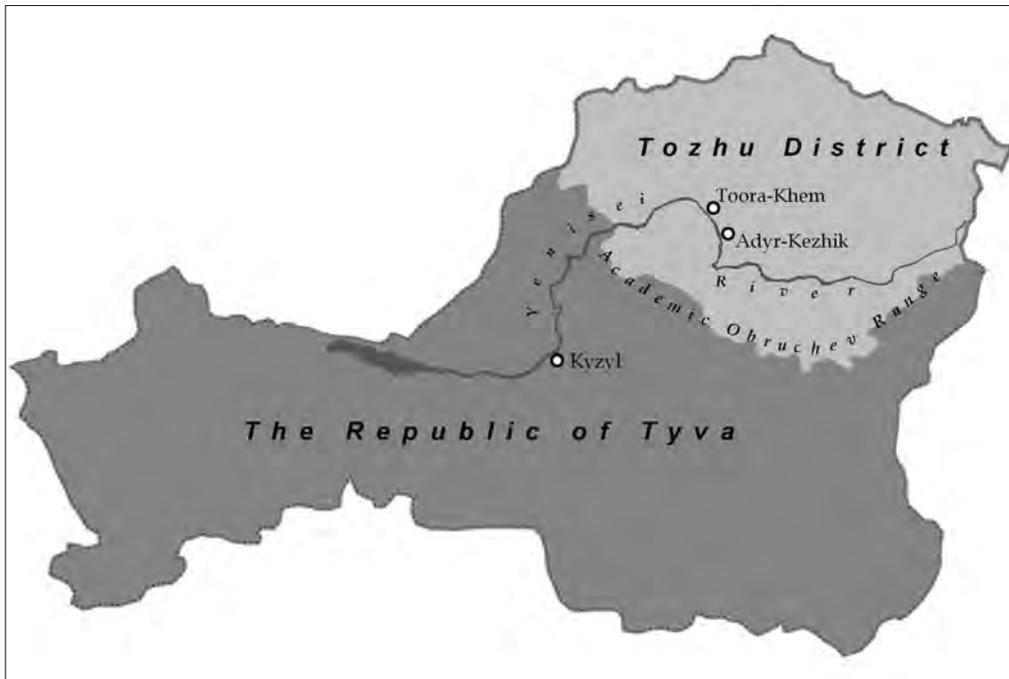


Figure 2. The Tozhu District and the Academic Obruchev Range in the Republic of Tyva.

free-range herding, short-distance seasonal migrations, use of dogs for hunting, use of reindeer for carrying packs, riding, and (occasionally) sled pulling (Anderson 1991; Anderson et al. 2014; Donahoe 2004; Fondahl 1998; Klokov and Krushchev 2004; Petri 1930; Shirokogoroff 1933; Stépanoff 2012; Vainshtein 1961). Because reindeer are used for transportation and hunting, the Tozhu usually avoid slaughtering them (Stépanoff 2012:291).

There is insufficient information about the number of reindeer kept by the Tozhu before the Soviet period. The figures published before 1917 are contradictory, ranging from 25,000 to 78,000 head of deer. The 1931 census data lists roughly 10,000 reindeer in Tyva (Vainshtein 1980). According to local scholar Kyzyl-ool (1971), 524 households owned 6,354 reindeer in 1930. In the next years the number of reindeer increased. Thus, in 1936 their number was 11,557 head; in 1939, 16,555 head; and by 1941, 19,000 head (Kyzyl-ool 1971). Today, the total number of reindeer has dropped significantly. The latest count by the agricultural department of the Tozhu District in October 2014 gives a total of 2,880 reindeer owned by the government in the district (SOATK 2014). The official number of private reindeer in 2014 was 1,000. The government-owned reindeer herding enterprise Odugen manages the largest number (1,880) of public reindeer. Thirty-five Tozhu families are members of this enterprise. The main goal of Odugen is to secure the present and future of reindeer herding in Tyva by providing government subsidies and veterinary help. In 2012–14, around one hundred people were actively engaged in reindeer herding in the district (SOATK 2014).

The Tozhu District covers almost one third (44,800 km<sup>2</sup>) of the republic's territory. The district is situated in the Todzha basin. The climate is continental and moderately humid. According to long-term meteorological data gathered at Toora-Khem station in the district's center (Fig. 2), the average temperature in January is  $-28.7^{\circ}\text{C}$  and  $14.6^{\circ}\text{C}$  in July. The average annual temperature is  $5.5^{\circ}\text{C}$ . (State National Park "Azas" 2013). Rainfall is frequent in July and August, particularly in the highlands, which leads to good grazing conditions in summer. Average annual precipitation in the highlands of the Sayan Mountains (1,400–2,000 m) ranges from 700 mm to 2,000 mm (Muranova 1973:66). Snow starts falling in October, with an average winter snow depth of 25–30 cm in the lowlands to more than 100 cm in the highlands (State National Park "Azas" 2013).

The Sayan-type of reindeer herding practiced by the Tozhu relies on a specific social unit called an *aal*, or no-

mad's camp. An *aal* usually consists of several economically independent households, which are often related by kinship (descent) or marriage (alliance). While the individual families disperse in winter, they regroup in summer and set up their tents about twenty to forty meters apart. The success of an *aal* depends on the ability to help each other during seasonal migrations and joint efforts in carrying out different tasks. Also, "the demands of a severe climate require the people to be united" (Arakchaa 2009). Despite the enormous historical and social changes that occurred in Tyva throughout the twentieth and early twenty-first centuries, the basic social structure of the Tozhu *aal* has not undergone major transformations (Kuzhuget 2006). A main difference is that nowadays *aals* are more often composed of a single household, as the number of reindeer herder-hunters has declined drastically since 1991. That being said, the number of members of a given *aal* typically varies seasonally. In the fall, when fur hunting season opens, men typically leave the village and join the *aal*. Among them are young men and teenagers coming to help train young bull reindeer to be ridden and work as draft animals. Women and children usually join their *aals* during summer break.

Tozhu herders do not use sleds because the landscape is heavily forested and mountainous. They migrate several times a year depending on weather and pasture conditions, reindeer behavior, and hunting and fishing seasons. Even though a few families have managed to buy a snowmobile,<sup>1</sup> reindeer remain the most reliable means of transportation. The Tozhu keep small-scale herds of reindeer (typically forty to sixty animals of mixed ages and sexes) and do not use them as food except for their milk, with the exception of sick or old animals, which are slaughtered for meat. Today, herders usually slaughter three to five reindeer per year for cash. Herds are moved across grazing areas throughout the year. In summer, herds are taken into mountain pastures and then back to the valleys in the fall. Herder-hunters live in canvas tents in summer and in log cabins in winter. Reindeer graze freely very close to the *aal*, especially in summer when pastures are full of different grasses. In order to keep the reindeer close or make them come back to the *aal*, herders attract them with salt (Stépanoff 2012:292). Human urine is sometimes used as a substitute.

As with the Evenki, and many other southern taiga peoples, Tozhu have ridden their reindeer to hunt big game and fur animals, as reindeer can move swiftly through the taiga year-round (Fig. 3; see also color plates). In addition to keeping reindeer, dogs are considered the

best hunting partners (Davydov 2011; Petri 1928, 1930; Tugolukov 1969). In the context of an *aal*, both reindeer herding and hunting are important. During my interviews and conversations with *aal* members, I asked questions such as: What activity is most important for you—herding or hunting? Do you consider yourself more a hunter or more a herder? Some participants replied that reindeer herding is more important. Others responded that both activities are important. A majority of answers, however, made clear that “*bis anchylar ives, ivizhiler bis*” (“we are not hunters, we are herders”). I suggest two reasons for this preference. The first reason is that large-scale reindeer herding with its meat-oriented production was imposed during the Soviet era, and reindeer herding became the primary activity in the Tozhu District. The level of production was so high that “herders” had to constantly look after the reindeer and had much less time to go hunting. The second reason is that reindeer are not the only animals that have been domesticated in Tyva. Sheep, goats, cows, horses, yaks, and camels are also culturally valued as “herdable” species. While some indigenous groups in the Republic of Tyva herd more than one animal species, the Tozhu have always relied predominantly on reindeer. Their herding culture also differs in that reindeer are not so much treated as a source of meat, as they are as providers of transportation and milk. Reindeer are the means and the *sine qua non* for hunting. Reciprocally, hunting requires the mobility skills and “flair” of reindeer. This explains in part why my research participants call them-

selves *ivizhiler* (“reindeer people”) and not *malchynnar* (“herders”) (see also Donahoe 2012:111–113).

### ETHNOGRAPHIC FIELDWORK IN THREE *AAL*

I carried out fieldwork among Tozhu reindeer herder-hunters in August 2012, July 2013, and November–December 2014. Even though I am originally from the Republic of Tyva, I am not Tozhu, and it took time to gain access to the sites where reindeer are kept in summer. Besides lengthy administrative procedures, I had to find a local guide willing to take me from the village of Adyr-Kezhik to the highlands. Fortunately, a married couple of reindeer herder-hunters happened to be in Adyr-Kezhik in the summer of 2012—babysitting their newborn granddaughter—and agreed to take me to their camp (Fig. 4). Sayzana Kol and Andrey Baraan have been reindeer herding and hunting for the last twenty-two years. They have a good reputation in Adyr-Kezhik and other herder-hunters describe them as very mobile, often migrating to explore the land. Sayzana and Andrey also helped me rent a horse, as this was the only way to get to their *aal* through the mountainous taiga.

Tozhu families that are involved in reindeer herding and hunting divide themselves into two geographical areas: the Serlig Khem region and Odugen taiga. The natural border between these two areas is created by the Serlig Khem River. This river is a southern spur of Bii-Khem



Figure 3. Riding reindeer across the Obruchev Mountains, Tozhu District, summer 2012.

(Big Yenisei) River. The Serlig Khem region lies in the central part of the Academic Obruchev Mountains. Odugen taiga lies to the north of the Serlig Khem River. I visited Sayzana and Andrey's camp in Serlig Khem for the first time in August 2012. It took us five days on horseback to reach their *aal*, located 93 miles from Adyr-Kezhik. From there we took a short trip (two hours by reindeer) to the camp of their neighbors, Cheinesh and Galin-Kys Baraan. That same summer, I also stopped at Sergey Kyrganay's *aal* on my way back to Adyr-Kezhik. It took us two days of reindeer-riding to reach Sergey's camp. I chose to visit him again in July of 2013 because he is a respected elder and has a great knowledge of animals and the environment. Younger people often visit him to ask for advice about animals, herding, and hunting. Finally, I visited Sayzana and Andrey in November–December 2014.

I had never ridden a horse or a reindeer before and my horse ignored most of my commands. Even the relatively simple task of mounting my gelding was difficult for me. While Sayzana and Andrey easily hopped on their horses, I could not hoist myself onto mine. We rode between six and nine hours per day, which left me sore and in pain. When we stopped for breaks, I could not walk normally for ten to fifteen minutes and could not help my

guides gather firewood. Riding a reindeer was even more challenging. I had trouble maintaining my balance in the saddle, which wiggled side-to-side with each reindeer step, leaving me on the ground several times a day.

In the camps, I interviewed eight herders from four households in Russian and Tyvan. My interviews focused on climate change. I asked research participants to reflect on climate change—how is climate change affecting reindeer herding, hunting, fishing, and gathering activities? A basic understanding of human-reindeer relations, as well as human-horse relations, was necessary before I could evaluate the local impacts of climate change.

It is impossible to understand current reindeer behavior and ecological conditions in Tyva without a knowledge of the Tofalar subspecies, one of the tamest reindeer in the world. I quickly noticed that Sergey's reindeer were tamer than those I saw at Sayzana's and Andrey's *aal*. As of 2013, Sergey had fifty reindeer that were not afraid of people. Some of them would even try to enter the tent. Accustomed to receiving salt before being milked, female reindeer were particularly good at sniffing around and sticking their muzzles into people's pockets. They sometimes even tolerated being petted without running away. According to Sergey, this taste for salt has a direct impact on herding



*Figure 4. Anoka Kol, Sayzana Kol, Vika Kol, and Andrey Baraan having a lunch of red deer dumplings in Saryp Salyg Bazhy, Tozhu District, August 2012.*

practices. “We do not use a lasso. We use only salt to catch a reindeer. You don’t need to use a lasso because if you use it reindeer will be afraid of humans and it will be difficult to catch them. Why do you need to use a lasso? It is enough to use salt to catch them” (Kyrganay 2013).

Tozhu herder-hunters also rely on horses. Usually each family has one or two horses. Horses are important, especially in summer, when herders come down from the mountains and cannot use reindeer to go back to the village. It is impossible to ride reindeer for long periods of time when the temperature exceeds 30°C. While not as suitable as reindeer in the mountainous taiga, horses are extremely valuable when commuting to and from urbanized environments. In August of 2013, Sergey Kyrganay described how convenient it is to have horses for the management of the *aal*:

We kept horses together with reindeer even during the Soviet period. Each family had two to three horses. My father had 400 to 600 reindeer and 20 to 30 horses. If reindeer are missing in the taiga, it is more convenient to look for them with a horse. It is so challenging when you do not have a horse. What are you going to do? Just walking! Also, a horse is very good for pack-riding. It is better than a reindeer while we migrate to another place because it can carry a load of 50 to 60 kg. A reindeer can carry much less. I had three horses in the past. My last gelding was stolen while I was in Adyr-Kezhik three years ago. It is so challenging to get to the village now. Recently we ran out of salt and it took me almost a week to walk to Adyr-Khezhik and come back to the *aal*. We very much need horses (Kyrganay 2013).

No more than forty to sixty reindeer per family are needed to sustain the *aal*. This number provides a cluster of households with milk and milk-based products such as *byshlak* (cheese), *aarzhy* (cottage cheese), *süttug shai* (salted milk tea), *süttug bydaa* (milk soup), *kasha* (gruel), and *gal'dan* (fry bread), all of which are integral to the local diet. Female reindeer are milked twice a day from April to the end of June and once a day from July to September or the beginning of October (Fig. 5). If a family, particularly one with young children, has very productive hinds, milk will be drawn until the end of December. In June–July when pastures are in very good condition, hinds give about 400 to 600 mg of milk in one milking. Reindeer milk is thick and creamy and contains 15 to 24.7% fat (Kertselli 1925; Sjenneberg et al. 1979).<sup>2</sup>

## CLIMATE CHANGE DATA

Recent studies on climate change have shown that south-eastern and central Siberia is warming (Andreychik 2012; Andreychik et al. 2008; Baranov et al. 2013; Cheredko et al. 2014). Warming poses serious threats to herder-hunters, such as melting snow patches, decreasing depth of snow cover, warming and decreasing water levels in rivers, and increasing forest fires (Baranov et al. 2013). Different areas of Siberia are affected in different ways. Thus, according to Cheredko et al. (2014), the average temperature has increased by 0.3°C per decade for the years 1961–2012 in the neighboring Republic of Altay. Winters have become colder and summers cooler for the last fifteen years in the republic. The only research on climate change in Tyva was done in the Ubsu Nur Basin, located in the dry mountainous steppe zone in the south (Andreychik 2012; Andreychik et al. 2008). Since 1976, temperatures have been warming by 0.4°C per decade in Russia (Rosgidromet 2011). While the warming rate in Tyva decreased by 20% in the years 1991–2006 (Andreychik et al. 2008), temperatures in the Ubsu Nur Basin have increased by 1.8°C for the last decade and by 2.2°C in the last thirty years. At the same time, precipitation decreased by 3.4%. According to Andreychik (2012:28), climate change in the Ubsu Nur Basin is reaching a near-critical level. No research has been done on climate change in Tozhu District. Data on temperatures in the highlands of the district are not available. The only meteorological station in the district is situated in Toora-Khem village, in the lowlands. One cannot compare the Tozhu District, with its taiga and forest tundra climate, to the Ubsu Nur Basin, with its dry steppe climate. However, the warming trend observed in the Ubsu Nur Basin in the last decade is not unique. According to the predictions of Alexey Kokorin, head of the World Wildlife Fund climate division, climate change in southern Siberia will increase desertification, thus limiting access to water and pasture for animals (Stracansky 2014).

## RESULTS

When the research participants talked about how changes in weather and environment affect their everyday lives, they related their concerns to their work and well-being as reindeer herders and hunters. These concerns include (a) hotter summer days, (b) rainier summers, (c) greater



Figure 5. Sayzana Kol milking a female reindeer in Saryp Salyg Bazhy aal, Tozhu District, August 2012.

weather unpredictability and not enough snow, and (d) an increasing number of predators and parasites.

### HOTTER SUMMER DAYS

All herder-hunters reported changes in the weather patterns observed in the last decade, particularly in the last six to eight years; the changes were seen as having a negative effect on *aal* communities and activities. As mentioned above, the average temperature in July in Toora-Khem is 14.6°C. A common observation is that summer days have become hotter, rainier, and wetter. Hot weather has impacted migration routes, as herders were forced to migrate higher and deeper into the Academic Obruchev Range in order to find summer pastures with cooler winds and fewer mosquitoes. In the past, summer camps could be set up at middle altitude. However, for the last several years, summer camps were established at the very top of the mountains, at altitudes of 2,500–2,800 m where reindeer may enjoy snow patches. The camp is usually established on an alpine plain in order to help herder-hunters check for their reindeer at pasture.

According to herders, the high temperatures of 2008–2012 also brought stress to animals and people. According

to Sergey Kyrganay (2013), hot summer days increased the number of mosquitoes and horse flies, which are serious pests that harass the reindeer. From June to August reindeer are particularly vulnerable to biting insects because they shed hair and are not heavily coated. Blood-sucking horse flies usually come out in the middle of July. They relentlessly attack the reindeer, exhausting them by making them run constantly. When reindeer experience heat stress and insect harassment, they become more vulnerable to diseases (Dieterich and Morton 1990), which in turn impacts the herd. When the weather is too hot, herders avoid riding reindeer for long distances. According to them, the most common disease affecting reindeer in these changing conditions is foot rot (Russ. *kopytka*) caused by a bacterium (*Fusobacterium necrophorum*; Dieterich and Morton 1990). On hotter days the reindeer suffer a great deal from insect harassment. Sayzana Kol described the situation in the following terms:

I noticed that the weather has changed in the last five to seven years. The summers became hotter. It is bad for reindeer because they become sick when it is hot. Usually they are limping or they have pulmonary disease. We give them injections such as gentamicin, penicillin, and bicillin for three to five

days as the vet prescribes. That is how we treat our reindeer in order to prevent suffering and death (Kol 2012).<sup>3</sup>

Welaji et al. (2003) found that insect harassment has a negative impact on the weight of reindeer calves as well as on milk production due to reduced grazing time and higher energy expenditure. More generally, reindeer do not receive sufficient nutrition from summer foraging, which is critical for accumulating enough fat for the rest of the year (Baskin 2009). According to Baranov et al. (2013), population dynamics of big mammals have changed due to global warming. In particular, the number of reindeer living in the mountainous areas of southern Siberia has been decreasing.

### RAINIER SUMMERS

Seven research participants suggested that the summer season in the Obruchev Range was not only becoming hotter, but also rainier and wetter. As far as they remem-

ber, summers have always been rainy in the mountainous area. However, heavy rains now seem to be more frequent. The weather in general and the winds in particular have become more humid. As a result, hunting is more challenging. The Tozhu persistently hunt for roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), elk (i.e., moose; *Alces alces*), wild boars (*Sus scrofa*), and brown bears (*Ursus arctos*) (Fig. 6). Thus, wild game is the main source of food for Tozhu reindeer herders as well as for their dogs (who are not used as shepherds but as hunting partners to track game animals). In August 2012, when I arrived at Sayzana and Andrey's *aal*, Sayzana's brother, Anoka, had just killed a young red deer. As Anoka told me (pers. comm. 2014), such a catch feeds a family of four people, as well as four dogs, for four to five days. Unfortunately, heavy rains prevent herders from traveling to distant areas where they could spend more time hunting. Elders such as Sergey Kyrganay consider it more challenging to lead a nomadic life today due to increased humidity. Two other research partners, who are retired and stay in the village,



Figure 6. Sergey Kyrganay departing for hunting Siberian red deer (*Cervus elaphus*) in Aaldyg Azhyk, July 2013.

believe that rainier summers are not good for the health and well-being of humans, particularly elders.

### GREATER WEATHER UNPREDICTABILITY

Seven research participants noted that it is becoming difficult to predict the first snowfall. According to Sayzana Kol (2012), in the past, the first permanent snow usually used to occur between October 15 and 20, which marked the beginning of the winter hunting season. As Sayzana and others explained to me, this time frame is not certain anymore:

In the past, the hunting season usually started on October 20. Now we hunt in November. But we do not know when the first snowfall will fall: Early November, as in recent years? Mid-November? Late November? We ask each other about [the timing of] the first snow, and nobody can predict it. The first snowfall used to bring a lot of snow immediately. Now it brings less snow (Kol 2012).

Hunting fur-bearing animals and musk deer (*Moschus moschiferus*) are the most important economic activities for the members of an *aal* because furs and glands are the only source of cash. Sable and musk deer are the main targets, and permanent snow cover is critical to catch them. For instance, in November and mid-December of 2014, the snow cover was not deep enough. The depth of snow was less than 10 cm in many places, particularly in the barren, stony places where sable take cover from hunting dogs. It was an unusual situation as the average snow depth for this season is 30 cm. With a snow depth of 20 cm or less it becomes quite challenging to catch fur animals who run faster on shallow snow. As the process of chasing and hunting fur animals becomes longer (Anoka Kol, pers. comm. 2014), herder-hunters can be heard complaining *Khar chok, khar chok* (“No snow, no snow”). In 2014, the snow finally came in the middle of December. Hunting conditions were good only for a couple weeks, after which sable became scarce. Typically, herder-hunters hunt every day until the end of December. But by the end of the month in 2014, they were hunting only a few times a week (depending on weather and camp location).

Sable and musk deer are distributed throughout much of southern Siberia and are highly valuable animals in the Russian and Asian fur markets. Historically, sable in Tyva have been harvested for Chinese and later Russian colonizers who cherished the softness of their

fur. Today, Tozhu herders sell them primarily to *kommer-santy* (“traders”), receiving between 700 and 5,000 rubles (\$10–\$53) for a sable pelt, depending on its size, color, and quality.<sup>4</sup> Musk deer are highly prized for their musk glands. Herders receive up to \$199 for a large gland (20 grams at about \$10/gram).<sup>5</sup>

*Aal* members do not consider the (slightly) delayed first snow to be a very serious issue. However, they consider it “annoying” to wait without knowing exactly when enough snow will cover the ground. As the hunting season becomes more challenging, fewer animals are taken, which means less cash for the *aal* economy. That being said, some individuals are taking a proactive approach to environmental change and are adjusting their hunting practices. Sergey Kyrganay and his son Danil, for example, decided to start hunting on October 20, whether or not snow permanently covers the ground:

We do not wait for snow to come. We do not need snow to go hunting because we have very good hunting dogs. Why do we need to wait for snow? Our dogs are the best in this area. They track animals and we follow them, and we find animals. They are so good when all three of them trace a musk deer. They always find it. Just train the dogs properly and you do not need snow to go hunting (Kyrganay 2013).

### INCREASING NUMBER OF PREDATORS AND PARASITES

Sayzana reported that there are now many ticks, especially at the bottom of the mountains, and that she was bitten in April 2012. It took her two days on horseback to get to the hospital in Toora-Khem. She completely recovered from the infection after two months of treatment, but she had to stay away from her *aal* for three months. Sayzana’s case is not isolated and “ticks are currently considered to be second only to mosquitoes as vectors of human infectious disease in the world” (Parola and Raoult 2001:897). According to Revich (2012), the increase in the number of ticks, as well as their longer activity period, may be related to global warming. In the 1960s and 1970s there was an average ratio of forty to fifty ticks per square kilometer in southern and eastern Siberia. Since the late 1970s, however, that ratio went up to 500–900 ticks per square kilometer in taiga forests (Encephalitis.ru 2013). Consequently, the risk of tick-borne encephalitis in southern Siberia (including Tyva) has also increased.

Another concern noted by the research participants is an increase in the number of bears and, more significantly, wolves, which sometimes attack the herd. More often than in the past, Tozhu herders have to abandon pastures and change their migration routes to avoid high numbers of wolves. I was told that wolves living close to the camp cannot be killed because they would come back, seek revenge and take even more reindeer.<sup>6</sup> Moreover, killing wolves just because they show up is seen as a “stupid” idea. Herders prefer to migrate as a response to the wolves in their pasturelands, even if that involves adding a few segments to the annual itinerary of migration.

Although global warming may contribute to the trend, *aal* members do not think that the increase in the number of predators is a direct effect of climate change. More commonly, they point out that wolves were eradicated in Tyva during the Soviet period (by professional state hunters who received money for every wolf killed, typically by poison or firearms), and that the dissolution of the Soviet Union in 1991 put an end to this program. According to the Ministry of Agriculture of the Tyva Republic, there were 2,397 wolves in Tyva as of 2011 (Murygina 2012). According to the administration of the Tozhu District, these wolves were responsible for killing fifty-seven reindeer in 2011. A bear attacked Sayzana and Andrey’s *aal* during the summer of 2013, and another bear attacked Sergey near his *aal* four days before my visit in 2013. More than climate change, Tozhu herders were blaming the lack of effective predator management by the local and/or federal authorities for these attacks and the harms and worries they caused.

## CONCLUSION

From the perspective of *aal* members, climate change is one of the many issues they face in their everyday lives (in addition to shortage of cash, lack of salary, retirement plan, and management within the Odugen enterprise). However, observations made by Tozhu reindeer herder-hunters over the last six to eight years provide evidence of climatic changes. This preliminary study suggests that the effects of climate change have been observed in the Academic Obruchev Mountains and their lowlands and are considered to have a negative impact on the mixed economy of the Tozhu reindeer herder-hunters. In particular: hotter summer days force the Tozhu to migrate deeper and higher across the mountain range and expose reindeer to more heat-related stress and diseases; rainier summers

and delayed snow cover make hunting more challenging; and a higher number of parasites (ticks) and predators (wolves, bears) complicate the already complex pattern of seminomadic reindeer herding and hunting in the Academic Obruchev Mountains. All research participants agreed that these changes have occurred within the last six to eight years and affect their main activity—hunting for subsistence and cash.

The observations made by Tozhu reindeer herder-hunters can help raise the public and scientific awareness of global warming and climate change in Russia. In order to support reindeer herding and hunting traditions in the Tozhu District in a sustainable manner, local and regional decision-makers must take into consideration the pressures recently experienced by the members of *aal* communities. Their concerns, as well as their unique first-hand observations of sociocultural and environmental changes, should be at the core of any government-sponsored program related to reindeer herding and hunting in the Tozhu District.

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## NOTES

1. A limited number of Tozhu families bought snowmobiles in the last two years. Despite their high purchase price and maintenance costs, these vehicles provide an easy means of transportation to the village. They save time and effort travelling, especially if someone needs to stay in the village for several days or months. In such cases, it does not make sense to ride a reindeer to the village because someone needs to bring the reindeer back to the camp as soon as possible. With a snowmobile, herders can travel whenever they need and bring supplies with them during winter. Owning a snowmobile is now a dream for many Tozhu herder-hunters, and some of them work hard during the hunting season to make enough money to buy one.

2. During the Soviet era, state farms (*sovkhov*) provided regular food supplies, which were brought into the taiga by tractors. State farms were also responsible for the social security of their employees (including a decent retirement plan). The amount of retirement money usually depended on years of employment and earned income. Nowadays, herder-hunters receive some retirement money when they reach the age of 50 (women) and 55 (men), but the amount is minimal (6,354 rubles per month, or about \$97 as of December 2014). This sum is not enough to make ends meet.
3. Seven other participants also supported Sayzana's observations that summer days have become hotter and animals suffer from heat.
4. From 2014 to 2015 the prices dropped by almost half in November 2014 due to the current conflict.
5. Since November 2014 the U.S. dollar has been getting stronger against Russian currency. Herder-hunters have been receiving \$199 instead of the usual \$350 for the same amount of gland.
6. Vainshtein (1961) reported similar findings from his fieldwork among the Tozhu in the 1960s.

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