

# The River Alazeya: Shifting Socio-Ecological Systems Connected to a Northeastern Siberian River

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**ABSTRACT.** One of the most remote Arctic locations, Andryushkino village of Yukaghir and Even peoples is located on the shore of the river Alazeya in northeastern Siberia, in the Lower Kolyma Republic of Sakha-Yakutia, Russia. The community is at the nexus of large-scale Arctic social and climate change resulting from economic shifts, permafrost melt events, and high temperatures. In this study, we approach Indigenous knowledge of climate impacts to water by investigating the role of the river Alazeya, which has enabled human life to thrive, given rise to the Indigenous governance of landscapes in the past, and today serves most of the Indigenous peoples in the region for their culture, food security, and well-being. To do this, we offer an ambitious system-change analysis of the socio-ecological context of the river basin and community by exploring oral histories recorded in the community between 2005 and 2020, combining them with relevant scientific literature and weather data from Russian measurement stations to detect and point to key messages of impacts. Our results confirm that the speed and extent of climate warming have increased since 1985. The flood event of 2007 in the village has especially been seen as a major climate change-induced catastrophe. We focus on the drivers of change from local history to present. We also investigate alternatives for future development of resilience and support for the Yukaghir culture, traditional ways of life, and language.

**Key words:** Andryushkino; wild reindeer; Alazeya River; climate change; Yukaghir; Arctic rivers

**RÉSUMÉ.** L'un des lieux les plus éloignés de l'Arctique, le village Andryushkino des Youkaguirs et des Évènes, est situé sur la rive de la rivière Alazeya, dans le nord-est de la Sibérie, dans la République de Sakha (Yakoutie) de la basse Kolyma, en Russie. Cette collectivité est au cœur de changements sociaux et climatiques d'envergure dans l'Arctique, changements découlant de virages économiques, de la fonte du pergélisol et de températures élevées. Dans cette étude, nous abordons les connaissances indigènes en matière d'incidences climatiques sur l'eau en nous penchant sur le rôle de la rivière Alazeya, qui a permis à la vie humaine de prospérer, qui a donné lieu, par le passé, à la gouvernance indigène des paysages et qui, de nos jours, joue un grand rôle dans la culture, la sécurité alimentaire et le bien-être de la plupart des peuples indigènes de la région. À cette fin, nous avons fait l'analyse approfondie du changement systémique dans le contexte socioécologique du bassin fluvial et de la collectivité en explorant les histoires orales enregistrées dans la collectivité de 2005 à 2020 et en les combinant avec de la documentation scientifique importante et avec les données météorologiques des stations de mesure russes afin de déceler les principaux messages en matière d'incidences. Nos résultats confirment que la vitesse et l'étendue du réchauffement climatique se sont accrues depuis 1985. Plus particulièrement, l'inondation de 2007 ayant touché le village est considérée comme une catastrophe majeure découlant du changement climatique. Nous nous concentrons sur les moteurs du changement, depuis l'histoire locale jusqu'à présent. Nous nous penchons également sur d'autres options en vue du développement futur de la résilience et du soutien de la culture, des modes de vie traditionnels et de la langue des Youkaguirs.

**Mots clés :** Andryushkino; renne sauvage; rivière Alazeya; changement climatique; Youkaguir; rivières de l'Arctique

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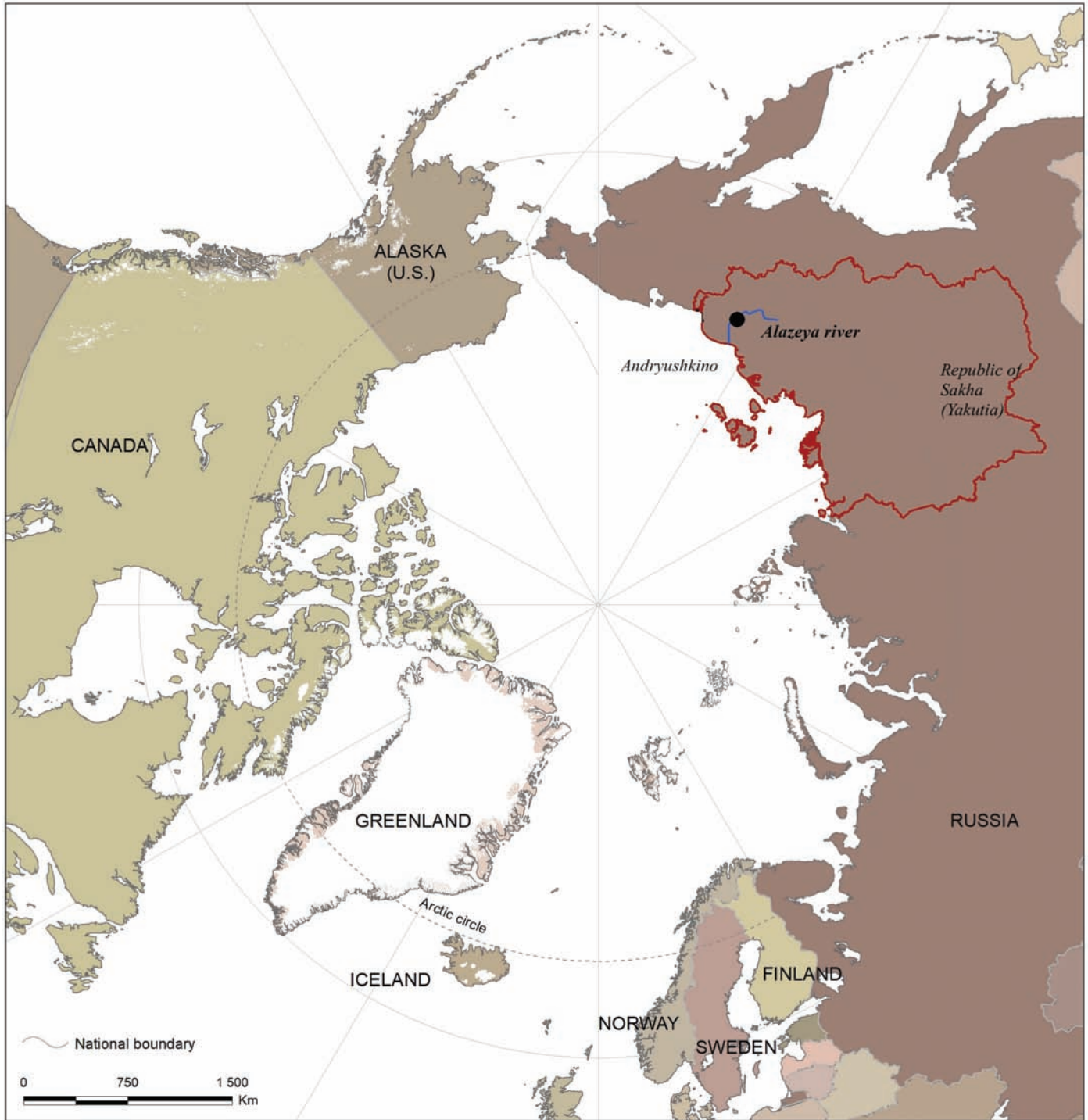


FIG. 1. Location of the Alazeya River in northeastern Siberia and in relation to the circumpolar Arctic.

Take a look, peoples of the Earth,  
Yukaghirs have lit a campfire.  
It may be small and weak  
But it is also hot and bright!  
Join around our campfire, brothers  
You can share in the simple beauty of our songs.  
You can bring and add your own firewood

Into the fire of our hearts,  
So that it will burn ever brighter  
And reach all the way to stars,  
So that the whole wide world  
Will see the small fire lit by the Yukaghirs.

Yukaghir Song

## INTRODUCTION

In this paper we, a Finnish geographer and an Indigenous geo-historian, combine oral histories, selected key scientific literature, and weather data to define and explore the questions of societal, climate, and environmental change in the Andryushkino community, Republic of Sakha-Yakutia, northeastern (NE) Siberia. NE Siberia has been identified as one of the key sites of change (CAFF, 2013). In this paper we focus on the community of Andryushkino, which was established in 1940 (Lewis, 2014). The river Alazeya (Rosvodresursy, 2014) and its local catchment area are central to this study, given the river's prominent role as a nearby aquatic ecosystem, food security source, and means of transport for the local village (Fig. 1). The 2007 flood event forms an important event for our paper because of its significance, scale, and cascading but varied impacts on the local communities. Subsequent flooding events have taken place in the region (Shadrin, in press). We investigate Alazeya and its peoples as a socio-ecological system (Pretty, 2011) as change permeates across sectors and systems at present.

The Eurasian Arctic, here understood to cover Fennoscandia and the Russian North (Mustonen and Mustonen, 2016), is home to dozens of Indigenous and local traditional peoples, such as the Sámi, Nenets, Komi, Karelians, Chukchi, Evenki, and the Yukaghir (AC, 2013; AMAP, 2017). These peoples possess endemic knowledge (Mustonen, 2014; Simpson, 2017; Brattland and Mustonen, 2018; Holmberg, 2018; Arttijeffer et al., in press) of their waters and also make observations regarding changes in the aquatic environments (AC, 2013; Johnson et al., 2015; Holmberg, 2018).

Many Indigenous peoples think of their rivers as female beings, and have gendered, bodily knowledge of their places (Colbourne and Anderson, 2020; Howitt, 2020; IPCC, in press). Many nations think of a “Master of Waters,” a spiritual overlord or a higher being that provides for the people if there is a respectful relationship (Slezkine, 1994; Holmberg, 2018; Colbourne and Anderson, 2020; Howitt, 2020).

Peoples in the Eurasian Arctic have Indigenous and local knowledge related to water that is understood to cover lakes, rivers, wetlands and marsh-mires, seasonal water bodies, as well as the Arctic Ocean and coastal areas across Siberia (Mustonen and Mustonen, 2016). This knowledge is reflected in the languages and knowledge-belief-practice systems of distinct peoples and their relationships with different waters in the context of climate change. One way to approach Indigenous and local knowledge of climate impacts to water in the region is to investigate the role of major rivers that, in their turn, have enabled human life to thrive, have given rise to the Indigenous governance of landscapes in the past, and today service most of the Indigenous peoples in the region for their culture, food security, and well-being.

Simpson (2017; see also Howitt, 2020) makes it clear that Indigenous peoples value and conceptualize their

knowledge as being relevant on its own and within its own interpretative context and significance without the need of “validation” by science. In Eurasia, this knowledge is made manifest through living oral histories, land use and occupancy, place names, customary relations and systems related to waters, and in many other ways (Rybråten and Gómez-Baggethun, 2016; Brattland and Mustonen, 2018; Holmberg, 2018; Howitt, 2020). Williams-Davidson (2017) has recently highlighted the gendered aspects of these relations (see also Feodoroff, 2020).

Many of the region's Indigenous and local communities are still relatively remote and dependent on the surrounding ecosystems for their food, well-being, and culture (Slezkine, 1994; AC, 2013). Economies of hunting, fisheries, and reindeer herding are seen as the dominant trades, especially in Siberia (Slezkine, 1994; AC, 2013). All of these traditional activities are reliant on access to water and the predictable behaviour of aquatic ecosystems (AMAP, 2017).

The region has long winters with seasonally ice-covered water bodies, which makes significant any change to the cryosphere (AMAP, 2017; Yang et al., 2020). The water-related ecology has adapted with the cryosphere alongside the dependent human systems. The most vulnerable species are cold-water dependent fish such as Arctic char, trout and other salmonids, whitefish, and burbot (AC, 2013; AMAP, 2017). Most of the Indigenous river systems are also fragile, and sudden shifts in the amounts of organic loading (Wauthy et al., 2018), nutrients, and erosion can have cascading impacts for Indigenous health and well-being.

Reindeer herding, especially in its nomadic form, utilizes rivers and frozen lakes for movement in the late autumn, winter, and spring (AC, 2013; AMAP, 2017), thus linking it with rivers and their basins. Many communities are connected with the regional capitals using ice roads and other seasonal cryosphere-dependent transportation (Mustonen, 2009). Warmer winters (Wauthy et al., 2018), loss of ice cover (Yang et al., 2020), unstable and sudden shifts in ice conditions, and danger resulting from these changes (Post et al., 2019) cause direct human and animal losses, stress, and hardships to many Indigenous communities (Colbourne and Anderson, 2020).

Winter and summer fisheries on the lakes and rivers of Eurasia have enabled survival in the coldest months of the winter across the region (Slezkine, 1994; Mustonen, 2014). The trap and seining fisheries of different Indigenous and traditional communities such as Khanty and Sakha-Yakut are sustainable but fully dependent on proper ice conditions (Mustonen and Mustonen, 2016). Therefore, the loss of winter ice and earlier spring ice melt in the spring cause a range of direct impacts (Yang et al., 2020).

Andryushkino and the river Alazeya are at a crossroads of Arctic climate and environmental change (Mustonen, 2009; CAFF, 2013; Rosvodresursy, 2014; Sakai et al., 2016; Meredith et al., 2019), as well as Arctic Indigenous survival (Shadrin, 2014). Past literature has identified the necessity and importance of surveying how small communities respond to environmental change (Huntington et al., 2017).



Andryushkino is a central Yukaghir community where the last tundra dialect speakers can still be found. While the community has undergone a range of negative socioeconomic events to various degrees during the past decades, it has preserved the traditional activities of reindeer herding, hunting, and fishing.

Macdonald (2000) encourages long-term oral history work with Arctic Indigenous communities. According to him, quick documentation of Indigenous knowledge can be enhanced by positioning the local people as co-researchers in an oral history context where the key events, issues, and narratives that people have consented to share publicly form an important source of history in the remote settlements of the Arctic.

In their long-term experience of working in NE Siberia, Vitebsky and Alekseyev (2014) stress that the issues of ecological change, reindeer herding, and Indigenous culture are often subjected to external ways of analysis. They stress the necessity of combining things-as-articulated by the knowledge holders themselves (see also Simpson, 2017). However, they acknowledge that the Indigenous ways of knowing and managing, for example, reindeer were in a long-term conflict with the rationalist-based Soviet views of reindeer herding (with herders seen as any other working class).

Methodologically we are including Indigenous knowledge, especially oral histories (Macdonald, 2000; Vitebsky and Alekseyev, 2014; Simpson, 2017) and community-based monitoring of environmental change (Berger, 1985; Moller et al., 2009; Newman et al., 2009; Pretty, 2011; Johnson et al., 2015; Lyver et al., 2019) over a 15-year period (2005–20). In this paper, we present the main community-based observations (Berger, 1985; also see Howitt, 2020 for context) and oral histories documented in our fieldwork over that time. We then position the key messages from the Indigenous knowledge into a dialogue with the weather data and existing scientific literature and ultimately explore divergence and convergence of observations and interpretations from these multiple knowledge sources (Johnson et al., 2015). Narrative analysis of Indigenous knowledge is a good way to achieve this goal (Cortazzi, 2001; Vitebsky and Alekseyev, 2014; Lyver et al., 2019; Howitt, 2020).

## METHODS AND MATERIALS

During our first visit to Andryushkino in 2005, we invited key Elders to participate as oral historians in a long-term study of change in the community. Initial long sessions with these co-researchers were made in Russian, Yukaghir, and Sakha-Yakut languages. Free, prior, and informed consent was collected, and all participants agreed to cooperate in the work. From 2007 to 2009, the primary materials were translated for the use of international scholars, and the central event of the 2007 flood was documented using literature surveys and visits to the community.

These fieldwork actions were also a part of the UNEP/GEF project “ECORA” (Kurvits et al., 2009). ECORA was a six-year-long international scientific and conservation project that assessed the status of ecosystems and Indigenous communities in the region. Both authors served as co-researchers in ECORA. The ECORA project also introduced small-business development and other socioeconomic initiatives in the region.

In 2009, summary oral histories from the first five years were released in a monograph (see Mustonen, 2009), which was followed by a peer-reviewed journal paper focusing on Indigenous knowledge elements from Andryushkino and other regions of Sakha-Yakutia (Mustonen and Lehtinen, 2013). Summaries of the documented observations from 2005 to 2012 were included in the Arctic Biodiversity Assessment (CAFF, 2013). Second author Shadrin continued field visits and the oral history documentation in the community between 2006 and 2018 (see Shadrin, 2014). Some gray literature reports on the aspects of Indigenous knowledge were released in 2016 (on star lore see Mustonen, 2016, and on environmental change see Mustonen and Mustonen, 2016).

Between 2005 and 2020 our key oral historians and co-researchers are as follows. The personal information shared here was at the wishes each individual.

1. Matrena Nikolaevna Tokhtosova, nee Kurilova. Born in Andryushkino in 1941, Elder Tokhtosova is Yukaghir and a seamstress. She lived in the settlement Tustakh-Sen until her family moved to Andryushkino in 1950. At the time, two local sovkhoses (state-owned farms) were united and the smaller closed. Her father worked as a merchant in the tundra. She studied in Yakutsk for a profession in the fur trade. Now a widow, she is a grandmother with seven grandchildren as of 2005.
2. Alexei Gavrilovitch Tretyakov was born in 1950 to an Evenki mother and Yukaghir father. He worked as a brigadier for reindeer herding.
3. Pyotr Serafimovitch Agafonnikov is an Evenki born in 1946 in Lagashkino, next to the sea, in the Lower Kolyma region. This outpost formerly had 5–6 houses on the East Siberia Sea but it has since been abandoned. He arrived in Andryushkino in 1955. His father was Russian, and Pyotr Serafimovitch Agafonnikov also has Yukaghir blood.
4. Ilya Vasilyevich Sleptsov was born in 1945 in the Olerinskaya tundra. From 1985 until his retirement, he worked as a professional reindeer herder in the village. He is now an Elder.

Oral histories were recorded using digital video and audio, following the signing of consent forms. Regular communication with the oral historians was kept during the project. Digitalised recordings were shared with the

local people as well as with the Institute of the Indigenous Peoples in Yakutsk and the Snowchange Oral History Archive. We also include oral history quotes from Podgorny (2010) who travelled the river system in 2008 and documented local observations.

## HISTORICAL AND SOCIETAL CONTEXT FOR ALAZEYA AND ANDRYUSHKINO

### *Pre-Contact through the Soviet Era*

The Andryushkino community has undergone a range of significant historical, social, and ecological changes. The Yukaghir are considered to have been the first peoples of the lower part of the river Alazeya, occupying the area since prehistory. ECORA (Kurvits et al., 2009) links them to be the continuation of the Ust-Belskaia and Ymyiakhtakhskaia archeological cultures. They practiced their Indigenous governance and seasonal rounds on the river catchment area and the coasts of the East Siberia Sea. They most likely had trade and conflict relations with their neighbouring Indigenous peoples, the Even and the Chukchi. In the 1600s, 14 Yukaghir tribal groups lived over a large area of NE Siberia (Filippova et al., 2013).

That the Yukaghir people are the original peoples of Alazeya is likely as the name of the river comes from a Yukaghir Alai clan. It is common in spring for coins to be thrown into the water as people ask the river for a good summer and safe travel. Trade between merchants and tundra camps took place during the pre-Soviet and Soviet periods. Additionally, the coastal communities would trade fish with the reindeer herders for meat and skins. Travel occurred by dogsled and reindeer, including spring hunting trips for geese and ducks using dog sleds (with Indigenous governance and self-restrictions, see Kurvits et al., 2009). Merchants would sell sugar, flour, macaroni, biscuits, and tobacco. No cabbage was then available; this Russian-introduced staple points to the influences of the Soviet supply chains, which came later.

The first recorded contact with the outside world was in 1642 when the Chukchi and Russians became the first outsiders recorded on the river and the first to encounter the Yukaghir. This encounter resulted in the expansion of trade, Cossack rule, and taxation of the Alazeya area. Citing Iochelson, the Russian explorer and ethnographer who visited the Lower Kolyma in the late 1800s, Filippova et al. (2013) say that the population close to Alazeya was 595 in 1850 and then dropped to 273 in 1897. Iochelson was able to document the life of the region as a participant in Russian and international expeditions that visited the region in the late 1800s and early 1900s (Filippova et al., 2013).

During the 1800s, the Chukchi arrived in greater numbers in the Kolyma area in search of new pastures for the reindeer and also to contribute to trading markets (Baskin, 1986). According to oral histories, in the early parts of the settlement and construction history, many

nationalities lived in Andryushkino, including Russians, Belorussians, and Uzbeks. Oral histories remain a critically important source of events (Macdonald, 2000) due to the minimal ability of Russian/Soviet histories to convey direct Indigenous mind-memory-narrations (Howitt, 2020).

### *1900–39*

During the 1920–30s, only a few dozen Yukaghir lived in the region. The historical losses of the Yukaghir populations resulted from waves of epidemics, the impacts of being displaced from their historical home areas, and the establishment of Russian and later Soviet rule (Filippova et al., 2013).

In 1917, the October Revolution meant that surrounding territories amalgamated with the Soviet Union, and a range of collectivisation measures (described below), combined with a war against the local spiritual people took place until the 1940s. The emerging Soviet power arrived in the Lower Kolyma in force during the 1920s and reorganized the life and traditional occupancies with the creation of the administrative region of Yukagi-ro-Eveno-Chukchi. The early collective farms of the region included Syrdyk Kyym (“Light Spark”), Chaylarul Vadul (“Awakening Yukagir”), Krugovatay Nainyukla (“Lake Krugovatay artel”) and Hutannya Omchik (“Red Territory”) (Filippova et al., 2013). The introduction of reindeer herding to the Yukaghirs also happened at this time to a large extent (Table 1). During the 1930s, all early artels (cooperatives of light handicrafts and industries such as fisheries and reindeer herding) were amalgamated into the mostly Yukaghir-populated Chaylarul Vadul and Even-based Hutannya Omchik. Hercharkin was an early Chukchi collective in the region. All private lands and assets that were considered *kulak* (in private peasant ownership) were confiscated and transferred to the collectives.

### *1940s Onwards and the Soviet Power*

In 1940, Andryushkino was established by the Soviet Union as a primarily Even village. During the 1950s and 1960s, the Soviets disbanded many smaller settlements along the East Siberia Sea coast and the Alazeya River and in the wider region that they considered to be villages without prospects (Lewis, 2014). Many families were then moved to Andryushkino, which, while at first a predominantly Even village, became after 1957 a complex social community of Evens, Russians, Yukaghirs, Yakuts, and others (Lewis, 2014).

Chaylarul Vadul transformed into the collective farm (kolhoz), one organized as a production cooperative, of Olenevod (“Reindeer herder”) in 1940 on the river Tustakh-Sen. Lewis (2014) reported that in 1957 the predominantly Yukaghir community of Tustakh-Sen was abandoned and the tundra Yukaghirs were forced to move to Andryushkino. This forced relocation caused the Yukaghir culture, language, and way of life to assimilate and start

TABLE 1. Summary of the reindeer herding and economic communities established in Andryushkino and Nelemnoye (a forest community in Middle Kolyma where Yukaghir are still living) from 1930 to 2020.

	Andryushkino	Nelemnoye
<i>Artel</i> , partnership, collective farms	1929 – <i>artel</i> Chaylarul Vadul (“Awakening Yukaghir”) 1933 – collective farm Chaylarul Vadul 1940 – collective farm Olenevod (Reindeer herder) then renamed the Nizhnekolymsky reindeer-herding <i>sovkhos</i> . In 1940, Olenevod was handed to the Dalstroy GULAG system. The collective farm’s reindeer and reindeer-herders were relocated by force to the river Omolon close to the GULAG camps (see Vitebsky and Alekseyev, 2014)	1930 – Yukaghir partnership 1931 – collective farm Pochorhodol modol (“Bright Life”)
Enlarged collective farm	1955 – the collective farms Sutanya Uderan and Chaylarul Vadul were merged into an enlarged collective farm named after Stalin	1958 – collective farms “Bright Life” and “Soviet Constitution” were merged into the enlarged collective farm Yukaghir
<i>Sovkhoz</i> /state farm	1961 – state farm Nizhnekolymsky 1982 – state farm Olerinsky	1960 – state farm Verkhnekolymsky
<i>Obschina</i> community, partnership, agricultural production cooperative	1991 – Chayla <i>obschina</i> 1992 – Orolchach and Alazey <i>obschinas</i> 1993 – production cooperative Agros 1998 – Chayla, Orolchach, Alazeya, and Agros production cooperative united in the Chayla <i>obschina</i> 2008 – the Olerinsky <i>obschina</i> , the Albay <i>obschina</i>	1991 – <i>obschina</i> Yukaghir 1992 – <i>obschina</i> Tekki Odulok, Odul 1993 – <i>obschinas</i> Yukaghir, Tekki Odulok and Odul merged into the <i>obschina</i> Tekki Odulok
Now	Olerinsky <i>obschina</i> (reindeer herding), Albay <i>obschina</i> (horse breeding, fishing, hunting, mammoth bones)	Tekki Odulok <i>obschina</i> (hunting, fishing)

to fade away (Filippova et al., 2013). The collective farms of Chaylarul Vadul and Sutan Uderan were amalgamated into a single collective based in town. The events of 1956–57 also sped up the construction of modern housing in Andryushkino, and many outside construction workers arrived to build the town in this period. Some Evens re-identified as Yukaghirs at this time.

While the Soviet era allowed a steady supply of services and items, social controls were strong (Vitebsky and Alekseyev, 2014). Active persecution and even murders of spiritual people caused fear amongst the northern peoples. The people of Andryushkino reported a feeling of freedom and decision-making devoid of control when they were hunting and fishing. According to our co-researchers (oral historians), women remained the central decision-makers in the families, which may be a Yukaghir cultural trait (Vitebsky and Alekseyev, 2014).

### Shifting Reindeer Herding Stages

Throughout this time, reindeer herding was an important traditional livelihood in the village. Filippova et al. (2013) describe the increases in the number of reindeer during the collectivisation of late 1930s until after the war in the late 1940s. These increases were due to more planned nomadic routes and uses of pastures, the introduction of horses for the herders, and the establishment of permanent reindeer corralling sites. The amalgamation of herds also allowed the collective farms to establish fishing and hunting sectors on the side. Sutanya Uderan, one of the Even-dominated collective farms, was located in Andryushkino during the

1940s. This period was also associated with a strong state campaign for education, overall improved health, and the development of formal institutions (Filippova et al., 2013). The GULAG administration equally utilized herders and reindeer for their purposes in the region, especially at the junction of the Omolon-Kolyma Rivers, where the present-day community of Kolymaskaya is located (Vitebsky and Alekseyev, 2014).

In 1955 a collective farm was renamed after Stalin, but in 1961 this collective farm switched its name to Nizni-Kolymsk *sovkhos* (Filippova et al., 2013). This period led again to many social changes and included a brief debate in the 1970s on whether to close Andryushkino (Filippova et al., 2013). The village was renamed Olerinsky (Filippova et al., 2013) and then Alazeya.

According to local herders, Andryushkino used to have 11 reindeer brigades in late Soviet times with about 20 000 reindeer, 2000 for each brigade. Good pastures existed towards Chokurdah. Some herding happened in Srednekolymsk (in the Middle Kolyma, another administrative area, Rosvodresursy, 2014). The pastures could accommodate seven herding brigades (Kurvits et al., 2009).

Lewis (2014) reports that the collective farm in Andryushkino was divided along ethnic lines in the village into three units, but all connected with a central governance. Tustakh-Sen, located 75 km east of present-day Andryushkino, was the central home of the tundra Yukaghirs until 1957 when these two communities were amalgamated.

Filippova et al. (2013) say that the 1980s were a period of stagnation in Andryushkino. Alcoholism, social ills, and



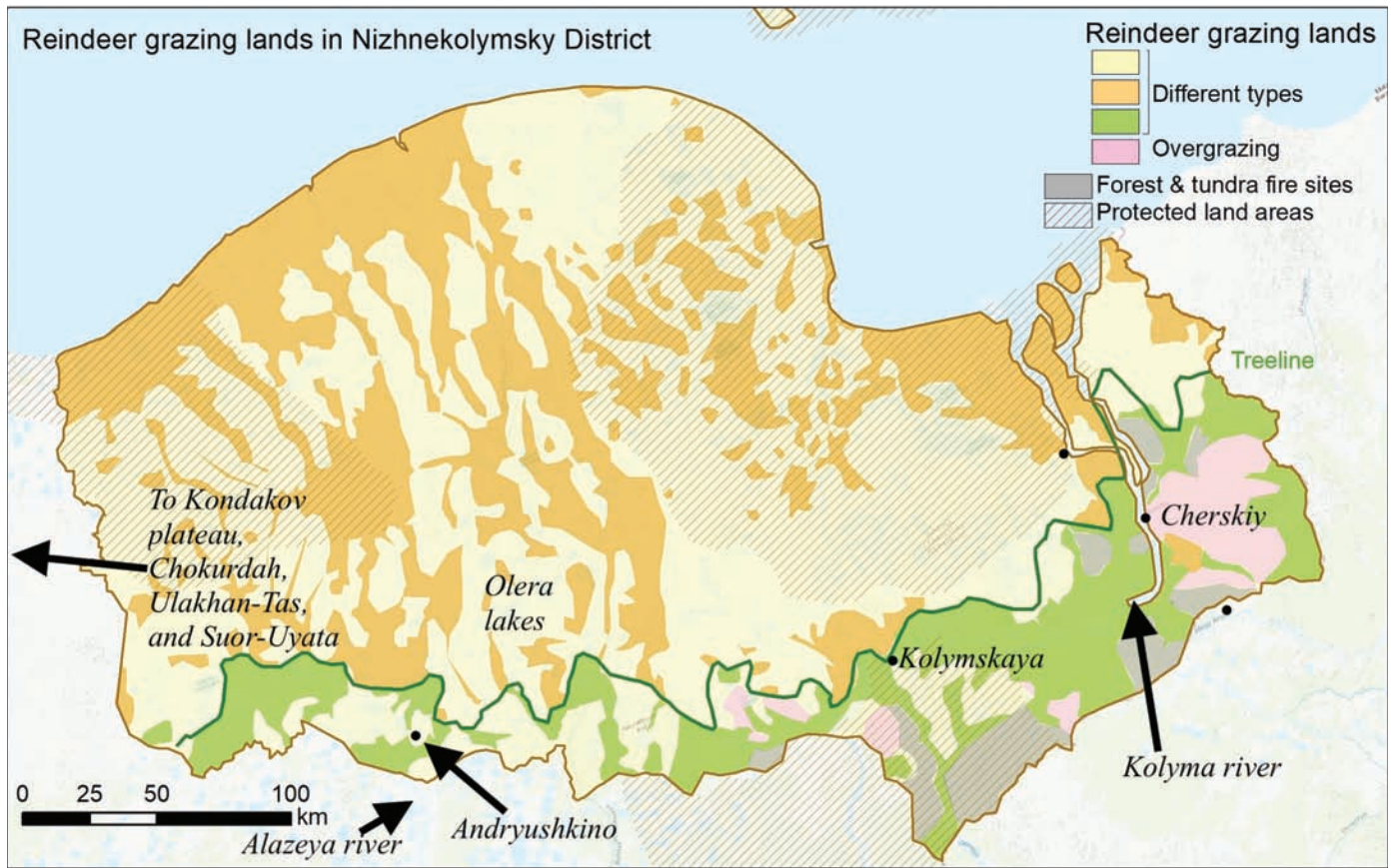


FIG. 2. Reindeer pastures around the community of Andryushkino. Map courtesy of Johanna Roto (2020).

underdevelopment of the economic trades were rampant. They characterize this era as having a mentality of social dependency. Shadrin (2014) discusses a number of oral histories regarding the 1980s in which the Yukaghirs were particularly associated with laziness, alcoholism, and abuse. The number of reindeer in the region was reported to be 13 506 in 1991, down at least 25% from the mid-1980s (Filippova et al., 2013).

In 1991 the Soviet Union was disbanded. Perestroika reforms initiated regional meetings of Indigenous peoples in the region. Nikolai and Gavril Kurilov travelled to Moscow to attend a meeting of the all-Union Indigenous organization that would become RAIPON. In March 1992, following the post-Soviet reforms, a Yukaghir-Even *obshchina* (a tribal-economic Indigenous nomadic community) named Chayla (a Yukaghir name meaning “dawn”), emerged in the region (Rosvodresursy, 2014:60). The Chayla *obshchina* was formed by the predominantly Yukaghir families in Andryushkino specifically to develop a Yukaghir-style economy (Filippova et al., 2013; Lewis, 2014). Chayla had three reindeer brigades at the time of formation (Lewis, 2014). Four agricultural enterprises also existed in the community: Saylyk, Kustuk, Kytalyk and Saydy, which reflect the Sakha-Yakut naming for these units.

Lewis (2014) reports that at its formation in 1992 the community of Chayla had 5000 reindeer, with primary

pasture areas located east of the village. As a legacy from the Soviet collective farm, the three reindeer brigades were still called #7, #8, and #9. Tustakh-Sen was located on the territory of brigade 9. Simultaneously, the last state collective enterprises, such as Olerinsky, were disbanded and other private small businesses like Orolchach and Alazeya were founded, and then amalgamated with Chayla in 1998.

Lewis (2014) reports that the number of reindeer after calving in Chayla during the early 1990s reached 7000–8000 animals in the summer. After autumn corrals (i.e., reindeer separation and butchering), the number of animals was again reduced to 5000 (Lewis, 2014). The *obshchina* sold a small part of the culled animal meat to cover the salaries and costs for the community. During this time, approximately 1000 animals (20%) were privately owned, with the remaining 4000 animals belonging to the community (Lewis, 2014). Chayla community members were also fishing and hunting.

Lewis (2014) and Filippova et al. (2013) report that by 1999 the herds had been reduced to half, or 2500 animals. At this time Chayla had 87 employees. Oral history sources indicate the partial collapse and problems of the brigades. Filippova et al. (2013) associate the collapse with the harsh market reforms, which meant the funds from herding were not enough to compensate for the costs of fuel, food, and equipment.

During our oral history work, Elders shared that between 1997 and 2003 a renewed reindeer brigade was reestablished, with 1000 reindeer and up to 1500 animals in 2003. After knowledgeable herders left the brigade in 2003, the number of animals quickly dropped to 866. In 2005, a second brigade had pastures northeast of Andryushkino, while a third brigade had pastures north of Andryushkino. One brigade travels along the river Alazeya. The sea is directly 202 km away.

In 2005 there were only three brigades remaining. Chayla *obschina* began with 4488 reindeer (according to oral history sources; Lewis, 2014 quotes 5000 animals), but in 2005 there were only 2617 animals according to data collected from herders for this study. In 2006 there were 1966 animals left, after a decrease of 374 animals from the previous year, according to official statistics (Rosvodresursy, 2014:60). This leaves a gap of 277 animals reported for 2005, which can be partially explained either by ownership of local reindeer or irregularities in the reporting. In the late 2000s, the Chayla community collapsed. Rosvodresursy (2014:59) reported that in 2008 there were 2467 reindeer in the community.

In the 2010s, the *obschina* Olerinsky was founded to continue reindeer herding and fishing. There were 4190 reindeer at the beginning of 2013, but numbers fell to 1727 by April 2019. Overall in the region the number of reindeer in the latter part of the 2010s faced drastic declines with 18 317 animals in 2017 falling to 13 094 by 2018 (Shadrin, in press). The key reason for these decreases was attributed to changing weather conditions. According to Filippova et al. (2013), there were only 12 registered Yukaghir reindeer herders and four professional fishermen in Andryushkino during the early 2010s. Shadrin (2014) says the number was as low as nine herders for 2013.

#### *Language and Changes to the Tundra Yukaghirs*

While elements of the nomadic lifestyle were preserved under the collective farms, the Yukaghir language was suppressed and discouraged (see Schmalz, 2012; Filippova et al., 2013). Soviet power destroyed the tribal governance and self-autonomous life of the Yukaghirs.

Today there are five languages spoken in the village, including Russian, Sakha-Yakut, Even, Yukaghir (Vadul), and Chukchi. Some Evenki people live along the Alazeya River. The community has the status of an official rural national Yukaghir settlement Olerinsky *Suktul*. *Suktul* refers to a 1998 regional governmental decision to provide the Yukaghirs with a means of self-autonomy and governance of their homelands (Filippova et al., 2013; Shadrin, 2014). Justification for this decision was the need to preserve the highly endangered Yukaghir language and culture. Shadrin (2014) reports that “ordinary” Yukaghirs were much in favour of the reform, perceiving it as a much-needed process to improve their situation. Organizations like the Council of Yukaghir Elders have also fought for national recognition of their Indigenous culture. According

to the 2018 census, the population of Andryushkino was 709, with people moving out of the village. The Yukaghir population in the community has developed in the past 50 years: in 1970, there were 81 Yukaghir; in 1979, 115 people identified as Yukaghir, and in 2018, 181 residents identified as Yukaghir (Filippova et al., 2013).

Shadrin (2014) reviews the process of identity in the case of the Yukaghirs and links it to language as well as the traditional occupancies of Indigenous peoples. The maintenance of Yukaghir identity was the central justification for the formation of the *suktul* in Andryushkino. On paper, the recognition of Olerinsky *Suktul* guaranteed equal access to services in the Yukaghir language, but in practice, this has been slowly realized with only a handful of street signs written in Indigenous terms. *Kolyma Pravda*, the regional newspaper, has initiated publication of news and announcements in Yukaghir, and regional assemblies such as the Congresses of Yukaghirs have paid attention to these matters (Shadrin, 2014).

#### *Current Situation and Socioeconomic Pathways*

As part of the wilderness economy, families gather cloudberries, lingon berries, and bog bilberries, among others. The use of mushrooms for food began after the 1950s. Willow were gathered in the summer, dried, and then used for firewood in the tundra in the winter. The switch from the wilderness economy to purchased items has caused economic hardship, especially for those social groups that are marginalized, such as pensioners, who may have difficulty purchasing meat and fish in the new economy.

Income levels in the village remain below the national averages. According to Rosvodresursy (2014:57–59), in the late 2000s, the highest monthly incomes were around 10 000 rubles (about US\$130 in October 2020). Officially, 35 people were registered as unemployed but in reality this level is higher. Average pensions were around 3500 rubles (US\$46 in 2020) in 2005 and up to 7246 rubles in the 2010s (US\$95 in late 2020). The Yukaghir language is taught at school in various capacities to roughly 39 children. As of March 2020, 117 students attended the local school.

The Alazeya River (in Sakha language Алаһыай), on the shore of which Andryushkino village is located, is central to the life of the community. Alazeya River is 1590 km long (Sakai et al., 2016) with a catchment area of 64 700 km<sup>2</sup> (Podgorny, 2010 gives a basin size of 74 700 km<sup>2</sup>, probably incorrectly). Elder Matrena Nikolaevna Tokhtosova commented on the river in 2005:

We like our Alazeya River a lot. It feeds us and we can use the boats to go where we want, even all the way to the sea. We give offerings to the river and ask that all summer will be okay. An Elder might collect some pearls and donate them to the Alazeya River, which carries them someplace.



The Alazeya River freezes usually between September and mid October (Rosvodresursy, 2014), although Sakai et al. (2016) say that the freeze-up during the 2010s has moved to November. The melt happens usually in May or June. Ice has been at its thickest (around 2.5 m) in May 1959, with a low of 107 cm of ice in 1963 (Rosvodresursy, 2014). The discharge of water at the Alazeya delta is 320 m<sup>3</sup>/s. The Olera lakes are important fishing and community use areas. One of the keystone species in the region is the wild tundra reindeer (identified genetically as *Rangifer tarandus sibiricus*) through the presence of the Sundrun subpopulation (Sivtsev, 2003). The domesticated reindeer, which are central to the Indigenous economy, have recognized “official” populations that were known in Soviet times as Even and Chukchi/Khargin stocks (Baskin, 1986; Kharzinova et al., 2016).

In terms of water quality and changes, the state report by Rosvodresursy (2014:22) has detected anomalies in the temporal regimes of the river. Low pH loading from fallen snow (e.g., 5.06 in 2009) causes the water pH to drop (e.g., in 2009 between 6.13 and 6.24). Increased iron (Fe) in the water measurements most likely results from soil discharge. Algae events have been detected occasionally (Rosvodresursy, 2014:41).

According to Rosvodresursy (2014), 22 fish species can be found in the Alazeya. For commercial and household harvests, the broad whitefish (*Coregonus nasus*), inconnu (*Stenodus leucichthys nelma*), and omul (*Coregonus migratorius*) are of major importance. In 2008, commercial fisheries were at 774–778 tonnes annually (Rosvodresursy, 2014:58).

In the most difficult post-Soviet years, the connection to the regional capital of Cherskiy was lacking. No airplanes, no helicopters, and no telephone connections existed. Now winter travel is only possible via a winter road and, in the summer, travel is by the river or by helicopter, which is costly. Cherskiy has the Antonov-2 plane to service the wilderness areas but it is often out of service. In the late 2000s, a new bus was assigned to the village, which allows winter road travel to Cherskiy. The northern sea route is used in the summer months to service the wider region (Kurvits et al., 2009). Beginning in the 2020s, this route has become a target for large federal geopolitical and trade ambitions.

Co-researchers have reported that youth have experienced many diseases and suicide events, which greatly affect the demographics of the village, and that the Yukaghir language was actively forbidden with only Sakha and Russian encouraged (Burtseva et al., 2014).

#### *Rise of Mammoth Trade and Decline of the Traditions*

In the 2000s, a new form of economic activity increased alongside and partly replacing herding and fisheries—the exploration for and selling of mammoth bones (Konttinen, 2019). In 2004, *obschina* Chayla licensed the right to collect mammoth tusks and other mammoth fauna on the coast of the East Siberian Sea between the mouths of the

Alazeya and Bolshaya Kuropatochya Rivers. According to these licenses, the community determined the annual level of extraction of mammoth tusks and other remains of mammoth fauna to be in the range of 3000 kg. The community could acquire this amount at its discretion if the finds did not have scientific and museum value.

In 2005 the community entered into an agreement with the company *Our Glacial World* to organize the sale of mammoth tusks and products. Helicopters were used to transport the products from the tundra (see also in Konttinen, 2009). The economic output of this enterprise developed so that the 2005 levels of income were 498 000 rubles (present value US\$6474). In 2007, income levels were at 2 250 000 rubles (present value US\$29 250) and from 2009 to 2020 income levels stabilized at 2–3 million rubles (US\$30 000–40 000).

In the 2010s, the mammoth bone work was carried out by a new *obschina* Albay, but the levels of income and operations have not been made public. Equally effective has been the recent General Prosecutors Decision in Sakha-Yakutia to review the mammoth bone harvesting situation and its framework, which has stalled the present authorized industry. However, a strong black market for the mammoth bone has emerged, which has involved and had a major impact on males between the ages of 19 and 45 in Andryushkino, particularly worsening the dependency on narcotics and illegal substances (Oral Histories, 2020).

Positioning the new industry (partly driven by climate change impacts and the loss of permafrost) into an Indigenous interpretative frame (Simpson, 2017), the positive impacts have been the creation of at least 20 new official jobs and many more unofficially (up to 50). Alternatively, the harvesting of mammoth remains has contributed to the loss of traditional ideas and cultures, given that the Yukaghir have held the mammoth in reverence and maintained strict taboos about it. The appreciation and continuation of traditional occupancies like reindeer herding and fisheries have also been lost among the youth. The actual mammoth harvesting activities contribute to the degradation of riverbanks (due to the large quantity of water used for excavation) and reductions in water quality (Konttinen, 2019).

#### *Reinterpretations of Yukaghir Indigenous Knowledge*

The Alazeya region is known even internationally for the preservation of tundra Yukaghir knowledge and cultural heritage. This knowledge and cultural heritage emerged also locally as many people in our oral history work referred to natural laws and how nature itself governs the hunt and the availability of animals, fish, and birds for game. Nature also punishes people who overharvest. Elders in Andryushkino also linked global events like world wars and droughts to the unavailability of animals and fish. They say that nature is responding and reacting to bad events.

Yukaghir knowledge of the tundra has been best preserved to date amongst the herding, hunting, and

fishery communities. Elements of this knowledge exist in the navigation of reindeer, for example, using the stars and the Big Dipper to tell the time during night. Sacred places on the tundra were respected and avoided as per guidance from the Elders. One example is Kisunohtar, where it is believed that a spirit lady in white has to be respected. Podgorny (2010) identifies Taas Kisiliakh, a group of tors, to be a significant site located 30 km from Andryushkino village on the right bank of the river Alazeya. Former dwelling areas of the shamans, such as the famous Tokoye (Oral Histories, 2020) are avoided and respected. Former campsites and locations of festivities from the Pre-Soviet era are recognized, where people have heard sounds and consider nature to “remember” the events and people in these places.

Mustonen and Lehtinen (2013) called these deep connections with the surrounding ecosystem “earthviews” (see also Howitt, 2020). Using oral histories from Andryushkino, they reported reciprocal relations with the hunter, a raven, and a number of animals and they argue that the tundra ecosystem surrounding the community is a sentient landscape of complex relationships and interactions.

Strong shamans in the past were living in the area (Mustonen, 2009). The Soviets started a re-education programme for the people to direct them away from shamanism, but people continued to practice in secret at least until the 1960s. Respect for certain animals such as the raven and brown bear has been preserved. Dreams are important and are used to interpret events. The ritual of feeding the fire is still preserved, and decisions can be made on the way the fire responds. Alexei Gavrilovitch Tretyakov commented, “Our Elders were still very close to the nature. We think here that we have a connection with the nature.”

Matrena Nikolaevna Tokhtosova conveys this deep knowledge in her oral history:

It is important to treat the fire so that it will not get angry. Once there lived a mean, mean person. He needed to migrate from one place to another and therefore he needed to put out his campfire. But he cleared a large area using the fire so that only the earth remained on that spot. He made a mess and used his axe to cut everything and then left. He arrived in a new place and started to make a fire. We were told this story. But the fire would not start. So he thought – okay, I’ll return to my former campsite and take the fire from there. So he went back. But there was an old man, a grandfather who was covered in blood, hit with an axe. The man asked: ‘Who did this to you?’ The grandfather responded: ‘You did when you chopped everything with your axe and left.’ The man said: ‘I went to my new place, but it seems I cannot light the fire there, so I wanted to get the fire from the old place.’ Grandfather replied: ‘You will not find the fire here either, because this earth is now such a mess, you cut everything here. Now you will never see a fire again. You will not be able to cook. And

you will not see fire ever again. The man went back to his camp and died without the fire.

Since the second half of the 1900s, the Kurilov family (Semen, Nikolai, and Gavril/ “Uluro Ado”), three sons of a shaman father, emerged as a formidable cultural force in the arts, literature, and study of the tundra Yukaghir language. The book by Semen Kurilov (1979), *Hanido i Halerha*, attracted international attention to the struggles of the Yukaghirs. This process was then advanced by the reforms of the 1990s, which supported the reforms for land and culture (Filippova et al., 2013), and the work of the Kurilovs, each in their turn, can be seen as a reinterpretation of the deep tundra knowledge embedded in modernity, science, and arts.

Positive cultural processes such as an Indigenous music group have been established by Polina Gavrilovna Khulyova to keep Yukaghir songs and music alive. This band has performed in the Golosa Severa Festival and even abroad, in California, USA. One Elder summarized her hopes for reforms: “It would be nice if more airplanes landed and delivered the mail. People are living very tight. The young people would need more apartments for themselves.”

Alexei Gavrilovitch Tretyakov, one of the knowledgeable Elders in the community, also summarized the main thoughts of the villagers on Yukaghir knowledge preservation and the interconnected changes to the river:

In recent years there has been a lot of water in the river system. Those houses located on the lower ground will all be submerged. River may even change its course. The culture is affected. Only the older people still sing the Yukaghir traditional songs. The youth use electric guitar and keyboards but these are not the traditional songs. UNESCO has been helping us a bit. But I am afraid everything will be forgotten.

## RESULTS

In this section, we position the community-based observations (Johnson et al., 2015; Podgorny, 2010) as well as observations recorded in scientific research since the early 1900s into thematic events that have influenced and affected Andryushkino and the river Alazeya within the memory and experience of the people. Due to the speed and severity of changes, most observations are post-1985. The primary observations are outlined in Table 2, which describes the observations and date, significance, and how the Indigenous knowledge deviates or converges with other sources of information.

The following themes are used as analytical frames: Traditional weather prediction and knowledge, observations and recorded climate and weather change, terrestrial ecological change, freshwater ecological change, and events that crosscut these divisions, such as changes to the river.

TABLE 2. Main Indigenous observations of change from 1900 to 2020 in the Alazeya River basin.

Observation	Time of observation	Significance	Deviance or convergence with science	Source
Prehistoric campsites and sacred places	2000–20	Yukaghir relations to land	Unknown	OR <sup>1</sup> , 2005
Russians and Chukchi first met with locals	1642	First contact	Convergence	Mustonen, 2009
Major event in nature resulting in wild reindeer	1904–06	Abundance of wild reindeer	Unknown	OR, 2005
Extremely warm year	1926	Very warm year, 1000 reindeer die	Unknown	OR, 2005
Flood Byybar	1936	Major flood	Unknown	Podgorny, 2010
Flood Ulakhan uu	1957	Major flood	Unknown	Podgorny, 2010
Two moons in the sky	1950s	Unknown	Unknown	OR, 2005
Up to 200 Arctic fox on a single hunt	1930–60	Loss of Arctic fox	Unknown	OR, 2005
Lakes were overfished in the Soviet era	1930–91	Loss of freshwater fish	Unknown	OR, 2005
Nets rotting in lakes cause water to foul	1930–91	Water quality loss	Unknown	OR, 2005
Alazeya floods in 10-year cycles	Prior to 2007	Cyclic water events	Unknown	OR, 2005
Extremely warm year with sunspots	1972	Very warm year, reindeer die	Unknown	OR, 2005
Establishment of the village (mainly Even)	1940	Soviet settlement	Convergence	Lewis, 2014
Large number of geese NE of the village	1948	Early local observation of geese	Unknown	Kurvits et al., 2009
Relocation from Tustakh-Sen	1957	Endemic harvests impacted	Convergence	Lewis, 2014
Cold winters, –50 to –60°C	1950–60	Continental temperatures	Convergence	OR, 2005
Thick river ice (2.5 m)	1959	Hard winter	Convergence	Rosvodresursy, 2014
Soviet era herding had 20000 animals	1940–80	Reindeer numbers high	Convergence	OR, 2005
Low level of river ice	1967	Mild winter	Convergence	Rosvodresursy, 2014
Soviet Union ended	1991	Reestablishment of governance	Convergence	Lewis, 2014
No wild reindeer	1985	Loss of wild reindeer	Unknown	OR, 2005
Sables appear in tundra	1985	Taiga animal in tundra	Unknown	OR, 2005
Alazeya started to change in early 1990s	1990–95	Melt events, changes begin	Unknown	Podgorny, 2010
Early 1990s, the reindeer number 8000	1980–92	Reindeer numbers dropping	Convergence	Lewis, 2014
Extremely warm year	1999, 2002–05	Very warm years	Unknown	OR, 2005
Only 2500 reindeer left	1999	Reindeer numbers dropping	Convergence	Lewis, 2014
2600 reindeer left	2005	Reindeer numbers dropping	Unknown	OR, 2005
Wild reindeer return	2005	Wild reindeer up to 20 000	Unknown	OR, 2005
Major forest fires in upper Alazeya	1997	Fires affecting river	Unknown	Podgorny, 2010
Massive flooding	2007–09	Major flood, village evacuated	Convergence	Sakai et al., 2016
Flood caused by the Kolyma hydrostation	2007	Flood	Divergence	Podgorny, 2010
Village evacuated	2007	Flood impacts	Convergence	Crate, 2017
Return to the village	2012	Last people return	Convergence	Crate, 2017
Repeated flood events	2012–15	Flood impacts	Convergence	OR, 2020
Mammoth bone collection	2006–20	Alternative economy	Unknown	OR, 2020

<sup>1</sup> OR refers to oral histories collected by the Snowchange Cooperative.

As Mustonen and Mustonen (2016) have identified, Eurasian Siberian Indigenous peoples often associate *events* (also known as a part of the earthviews, see also Mustonen and Lehtinen, 2013) with significant processes and change in their multisensory engagement with their homelands. This approach seems to be valid also for the community-based observations from Andryushkino. When science and Community-based monitoring materials disagree, these issues are documented and reviewed analytically.

### Traditional Weather Prediction

In the past, reindeer herding, a nomadic lifestyle, and fisheries have required careful knowledge and deliberation of the upcoming weather events and seasonal events. Both the winter high pressure associated with the Verkhoyansk area and northern Sakha-Yakutia and the low pressures from the Arctic Ocean and the East Siberia Sea, including cyclones, create a dynamic natural weather system for the community.

Winters are long and harsh, summers are short, and autumn and spring tend to be brief also (Sakai et al., 2016). The ground is within the continuous permafrost zone, with a 500 m depth and an active layer of 0.3–1.0 m (Sakai et al., 2016). Podgorny (2010) reported that the active layer reached

1.2 m in 2010. Climate change has been observed to alter weather systems and the predictability of the seasonal cycles.

During the oral history work, some traditional weather and nature-based prediction skills emerged:

- 1 April can be used to determine the spring weather. If it is cold this day, it will be a cold spring overall and vice versa.
- On 1 July it is important to monitor the direction of the clouds, since they determine the weather for the summer. A big cloud heading east will result in a warm summer, which will be bad for the reindeer herding because of a lack of grass.
- During mid-October, celebration of the Intercession of the Theotokos is an important marker day for winter weather and snow amounts.
- Snowstorms can be predicted from a circle around the moon or the sun.
- A west wind brings bad weather, while an east wind is usually associated with good weather.
- With a west wind, the reindeer start to jump and react to coming weather.
- Prevailing winds come from the south in Andryushkino in the summer.
- When the stars are very bright, it will be cold.



- Northern lights appear before the very cold weather, especially in December and January. They also can make a hissing sound. Some people were instructed not to look into the northern lights. They could sense them, feeling “pressure” in their head. The same applied to the moon, which should not be looked at too long.
- You can predict low pressures from the fish, since they do not bite before a low pressure. Also the mosquitoes come “lower.”
- 5 May is usually the time when geese arrive on the Alazeya River.

#### *Wild Reindeer as an Indicator of Changes in the Region*

Andryushkino and the river Alazeya have been considered to be in the periphery of both Russia and the wider world. For the local Yukaghir, the region was, of course, a homeland and, for the neighbouring Chukchi or Even, an area of trade and relationships in the past.

Although few scientific records exist for the early days, the trading relations between Alaska and Kolyma provide some insight into change and persistence of traditional livelihoods (Burch, 2012). The use of oral histories and community-based observations are important means to understanding long-term change, especially over terrestrial systems. For example, Burch (2012) successfully used far-reaching oral history work in northwest Alaska to explore the fluctuations of wild reindeer/caribou populations dating back to 1850. We are using wild and domestic reindeer as keystone species to assess change in the region as reindeer has often been named as the most important species transitioning across ecozones. There is no more important mammal for the Indigenous societies of the region in terms of food security.

The oral history documentation revealed the changes to wild reindeer populations:

- One Elder conveyed an oral history from 1904–06 when there was a “massive event in nature.” This meant wild reindeer became very abundant in the region and mixed also with the Khargin style reindeer.
- Alexei Gavrilovitch Tretyakov remembered that there were no wild reindeer in the area in 1985, but they came from the Krasnoyarsk region in the west. They can number 20 000 and occur both in the forest and the tundra. In 2005 they trampled all pasturelands; it takes eight years for the lichen to grow back after these trampling events. That same winter, they came close to the Lower Kolyma reindeer herds.
- In Soviet times, the wild reindeer were driven away from the reindeer pastures.
- Sable (*Martes zibellina*) appeared in the tundra around 1985.
- In former times a hunter could get 200 Arctic fox during one harvesting trip, but that number has dropped to perhaps 20 fox at one time. The cost of an Arctic fox has also fallen.

We also position the Indigenous observations with the literature and science of the Sundrun wild reindeer population (Safronov, 1996; Sivtsev, 2003; Kurvits et al., 2009). According to Safronov (1996), there are three major wild reindeer populations in Sakha-Yakutia. Calving peaks around 11–15 June (Safronov, 1996). Baskin (1986) highlights the historical role of the Chukchi in NE Siberia in hunting wild reindeer as opposed to reindeer herding. ECORA (Kurvits et al., 2009) mentions the total territory of the herd to be 180 000 km<sup>2</sup>.

During the 1970s, the Sundrun reindeer population was small and spent winters on the Kondakov plateau and at the Ulakhan-Tas and Suor-Uyata ranges (Baskin, 1986; Kurvits et al., 2009). From the 1980s up to present, these mountains became the main migration corridor and area of autumn and early spring pastures for the wild reindeer. Winter pastures are on the Alazeya plateau. Sundrun population returns to tundra usually early. At present, they arrive at Ulakhan-Tas and Suor-Uyata ranges and Kondakov plateau at the beginning of March from their winter pastures along a direct route via the Shangina basin (Kurvits et al., 2009).

Another resident herd (numbering around 14 000) lives near the large and small Olera lakes (Olera tundra), as does a migratory herd (Sivtsev, 2003). The numbers of the Sundrun migratory herd have fluctuated between 10 000 and 45 000 animals between 1962 and 1991, with a low of 10 000 in 1963 (Safronov, 1996). In 1982, there were 27 100 animals; a peak of 40 000 animals was counted in 1993, and that number had decreased to 29 600 in 2000 (Sivtsev, 2003). For the past 25 years, the average number of animals has been 30 000, although Baskin (1986) reported considerable under-representation in regional numbers during the Soviet years. Especially in the post-Soviet years, hunting has emerged as a major driver changing the gender ratio of the herd and herd numbers. In the late 1980s, 44 000 reindeer were hunted in all of Yakutia (Safronov, 1996).

According to Sivtsev (2003), the Sundrun herd of wild reindeer living close to Andryushkino was first identified by scientists as a separate population in the 1950s. He reviewed the early literature from the 1800s (explorer accounts, reports from Soviet and Russian scientists), which indicated that several wild reindeer populations lived in the wider Alazeya area at that time. The observations from the oral histories for the 1900s of the abundance of wild reindeer seem to agree. Safronov (1996) says the numbers were up to 600 000–800 000 for northern Yakutia.

Sivtsev (2003) documents that wild reindeer were mostly absent from the region from 1920 to 1950, with a return in the 1960s. The low number of wild reindeer could correspond with the warm year of 1926 documented in the oral histories, and the floods during the 1930s may also be a factor. Sivtsev (2003) says that a large wild reindeer migration took place to the Alazeya area in the 1970s, at which time they also expanded to the eastern side of the Kolyma River. The loss of wild reindeer in 1985 that is documented in the oral histories cannot be found in the scientific observations. Safronov (1996) linked the return

of the reindeer populations to the centralization trend of the society and closure of wilderness communities. The Sundrun population also suffered from regional poaching (Kurvits et al., 2009).

In 1995, the migration pattern of the Sundrun herd changed (Sivtsev, 2003). The herd calved later and much further south, and the migration pattern shifted to the Khalarcha tundra for the first time in 60 years (Kurvits et al., 2009). Turvaugin *obschina* reported that 16% (1598) reindeer amalgamated with the wild herd and were lost. This event may correspond to a very warm year in the regional weather records, which triggered a change in behaviour during the seasonal rounds. Sivtsev (2003) and Safronov (1996) also suspected mixing events with the neighbouring Yana-Indigirka herd at these times. Oral history reports stronger years, such as 2005, when the reindeer returned again. Wild reindeer are perceived to trample the pasturelands and thus affect the natural food sources of domesticated reindeer (Vitebsky and Alekseyev, 2014); this idea is partly disputed by scientists (Kurvits et al., 2009).

#### *Aquatic Ecosystem Change*

The Alazeya River is central to the health and well-being of the people of Andryushkino. With the Soviet-introduced settlement policy from 1940 onwards, many people spend most of their time in the community. Key aquatic locations are the lake Olera, other tundra lakes, and the coast of the East Siberian Sea, where many people subsistence hunt and fish.

Several changes to the aquatic ecosystem were observed in the oral histories:

- Some of the tundra lakes were overfished during the time of collectives.
- Fishnets were sometimes left to rot on the lakes, which affected the water quality and the fish in the lake.
- Overall the fish are now smaller and of lower quality.
- One Elder thinks that the Alazeya River has a decade-long cycle of droughts.

The topic of climate and weather change emerged as a central theme during the community work of 2005–20. Of utmost importance were the flood events, especially the one in 2007, which greatly affected the village and the people (see below). Since permafrost changes, water cycle shifts, and floods manifest in the river and aquatic realms, we investigate these impacts together thematically.

The oral histories documented several observations related to climate change:

- 1926 and 1972 were extremely warm years. Locals associate these warm years with leap years. In 1972, over 1000 reindeer died of heat stress. Many animals like horses, reindeer, and moose swam in the Alazeya River as it was so hot, but they died, mostly “because of the amount of mosquitoes.”

- The people observed many sunspots in 1972 associated with this warmth.
- A similar horrible amount of mosquitoes killed animals in 1999–2000. Over 400 reindeer died in Berezovka (middle Kolyma).
- 2000–05 were very warm years, when the Alazeya River water level was very low.
- The “soil” is nowadays more melted.
- Many lakes have disappeared from the tundra. For example, around Olera, the water “flowed out,” during a permafrost melt, which affected the fishery as many good fishing lakes disappeared.
- New birds, including waders, have appeared, including the “Japanese crane” (*Grus japonensis*).
- Many Elders said that the winters have changed. In the 1950s and 1960s it could easily be  $-60^{\circ}\text{C}$ , but these temperatures do not happen anymore.
- Podgorny (2010) reports that in the upper parts of the basin where Sakha pastoralists have their villages, lake discharges have been human-induced to acquire “more grasslands” for the animals. Lake discharges can also be partially attributed to natural erosion as opposed to human actions.

ECORA results state that there were many bird death events in the wider Lower Kolyma between 1996 and 2008 and were associated with the Arctic cyclone impacts (Kurvits et al., 2009). These events may have influenced the detection and attribution of “new” birds arriving after population losses or range expansions. Some important regional populations like Lesser White-fronted Geese (*Anser erythropus*) are nesting on the Alazeya (Kurvits et al., 2009). They also report that Snow Geese (*Anser caerulescens*) used to be abundant on the Alazeya River but were lost to hunting in the late 1800s. The present population of these birds is around 300 on the Alazeya delta. Another important goose for the region is the Tundra Bean Goose (*Anser serrirostris*).

Indigenous observations of birds include the accounts of the Elder A.N. Yaglovski who travelled by boat and foot in 1948 from Andryushkino to the mouth of the Chukochia River (a distance of 120 km). His trip included routing through the Olerinsky, Bolshoe, and Maloe Lakes. He reported that some of these lakes were “black” because of molting geese. At the time, the goose population was estimated at 10 000 to 100 000 birds. In 1977 the number of molting birds was no more than 100–200 birds along the same route. In 2003–09, only some birds were spotted on the same lakes (Kurvits et al., 2009).

#### *The 2007 Flood*

The contextual reason for the major flood of 2007 on the Alazeya River results from the energy balance that has shifted in the Arctic because of climate change, which influences snow and ice events and permafrost dynamics. This energy balance change also influences river discharges, lake formations and drainages, and floods.

Sakai et al. (2016) provide a detailed overview of the causes and impacts of the autumn 2007 flood event on the River Alazeya that affected the village and the basin:

1. Very warm conditions in 2006 and increased precipitation caused a large amount of water to enter into the Kolyma lowlands, along with waters from the permafrost melt areas. The deepening of the active layer of the permafrost affects surface water amounts.
2. 2007 was another extremely warm year. The air temperatures indicate twice the speed and amount of warming in NE Siberia compared to the global averages and the 1982–2015 mean.
3. The actual flood event took place between Svatai and Argakhtakh (upstream from Andryushkino) as a result of expansion and drainage of lakes and overflowing from these lakes when meltwaters entered the lakes and caused large amounts of water to travel downstream.
4. Thermal erosion of the riverbanks was the ultimate final trigger for the floods to break free and influence the downstream parts of the system.

The summers of 2006–09 had elevated water levels on the Alazeya River (Sakai et al., 2016). The Andryushkino area was hit hard with the large amount of water travelling in the river and an expansion of the width of the river to 5 km at the village site. The water area of the Alazeya at Andryushkino was 70 km<sup>2</sup> in 2006, 160 km<sup>2</sup> in 2007, and 130 km<sup>2</sup> in 2008. That year, it took one whole year for the waters to subside fully. The waters covered a large area for a long time. Sakai et al. (2016) explain this as a result of the lowlands in the area where the gradient is small so the waters remained extensive after the flood.

Podgorny (2010) outlined some of the results from the Alazeya-2008 science expedition. The chemical composition of the river had remained relatively clean. The flood had altered the vegetation of those sites left underwater for a lengthy period, especially willow areas. He estimates that 50% to 90% of plants in the directly affected flood area died.

Indigenous knowledge has noted cyclic flooding repetitions from the past (Podgorny, 2010), but the severity and impacts of the 2007 event were considered unprecedented. The majority of local people in the basin linked the flood changes in the river Alazeya regime to the increased amount of atmospheric precipitation and unplanned land amelioration (Podgorny, 2010).

Elder E.D. Kudrin-Bilge from Svatai linked the 2007 flood to the impact of the hydropower station on the neighbouring Kolyma basin (Podgorny, 2010). This Indigenous observation deviates from the scientific evidence and is unlikely given the distance to the Magadan region where the actual powerplant is located (Sakai et al., 2016).

However, Elder Kudrin-Bilge also foretold that the following three to four years (2008–11) would be dry years. He remembered dry years following floods, such as the 1936 *Byybar* flood (meaning “this is water” in the Sakha language), and the 1957 *Ulakhan uu* flood (“big water” in the Sakha language) (Podgorny, 2010). I.N. Sukhomyaso, another elder from Svatai, mentioned that about 10–20 years ago, there were large forest fires that could have impacted the river regime (Podgorny, 2010). Akulina Kondakova, the oldest inhabitant of Argakhtakh, had told of a yellow snowfall that occurred in winter at Balyksyt-Kyuelya Lake, after which all the fish disappeared (Podgorny, 2010).

Podgorny (2010) documented other oral histories from the basin in 2008 where Indigenous knowledge was linked with events in nature. Gavriil Nikolaevich Vinokurov told that a crane landed on top of one of the local houses on the eve of the flood; according to Indigenous knowledge, this was a bad omen. Albina Nikolaevna Nosova reported that in 1993–94 there was a large-scale outbreak of appendicitis cases (about 60 cases) in the villages of Svatai and Argakhtakh. Sometimes medical helicopters or planes had to come twice per day (Podgorny, 2010). As Howitt (2020) and Shadrin (in press) point out, omens, interconnected events, and seemingly divergent events form a coherent whole if seen from inside the nuanced and complex Indigenous worldview (Mustonen and Lehtinen, 2013), highlighting the need for further research on linkages and interpretations.

Andrei Grigorevich Vyrdylin, the head of the Council of Elders of Andryushkino, reported that a sharp change in the character of the Alazeya River began around the end of the 1990s. He unequivocally linked this phenomenon with the release of water from large lakes situated at Sen-Kiuel/Sen-Kyuel nasleg (a rural council and the area it governs in the Sakha Republic). He also mentioned that the climate has become warmer.

The permafrost events on rivers (Wauthy et al., 2018) contain secondary risks too. Graveyards of smallpox victims in the area called Uulaakh not far from Argakhtakh village are sites of importance. In 2016 in Western Siberia, a Nenets boy and thousands of reindeer died after the release of smallpox from melting permafrost sites; the latent danger of diseases released as permafrost melts is also very relevant for the Alazeya region.

Crate (2017) summarized some of the overall impacts of the 2007 flood for the basin and Andryushkino. All residents had to be evacuated, and while many soon returned, it was only in 2012 that pastures were used again in upstream communities, and normal subsistence and work patterns resumed in the villages. The fishery-dependent population of Andryushkino also tried to take advantage of the widened water body and access to new fishing areas.

Ksenofontov et al. (2017) documented a few families that had their livelihood affected by the permafrost-related disappearance of lakes. Overall, they documented lower fish catches associated with environmental change



in northern Yakutia freshwater systems, which affected community food security.

Podgorny (2010), in line with Sakai et al. (2016), confirmed that the results of the Alazeya-2008 science expedition determined that drastic changes in the hydrological regime of the Alazeya were the reason for the 2007 flood. Flooding of the settlements in its middle reaches was linked to climate change and the release of water from nearby lakes into the river system. The huge amount of water that accumulates in the form of floods in the areas next to the streambed cannot be drained quickly because of the basin's low natural stream gradient and the small natural cross section of the stream. These floods at various sections of the river apparently play a major role (Podgorny, 2010).

The Government of Sakha-Yakutia responded in a number of ways to the 2007 massive flood event (Kurvits et al., 2009). Local people were initially evacuated and later allowed to return to the community. The major science expedition of 2008 confirmed the root cause of the flood to be linked with extreme weather events. Food control walls and other flood mitigation measures were subsequently considered as a response but have not yet been realized (partly because of the 2008 financial crisis; Kurvits et al., 2009). During the 2010s, lesser flood events occurred each year except in 2019 (Oral Histories, 2020). However, we analyzed and highlighted the 2007 event as the main structural change of significance in the region.

### *Special Events*

As Mustonen and Mustonen (2016) and Johnson et al. (2015) point out, Indigenous knowledge may contain elements that fit uneasily with scientific and modern worldviews. To the Yukaghir, the Alazeya tundra and river area are alive and have “personhood.” As discussed in the introduction, the Elders especially preserve customary laws and proper behaviour with respect to access, avoidance, and observance of special places, such as the shaman graves and former campsites. Such interconnected human-environment systems have been called socio-ecological systems (Huntington et al., 2017).

For example, during the oral history work, an observation was made that in the 1950s “two moons” had appeared in the sky, but the second moon had diminished and disappeared after a while. The Elder conveying this particular event is very realistic and skeptical of many events that are “folkloristic,” but he could not explain or rationalize this event. These two moons were witnessed by the whole nomadic brigade at the time, and many people were very scared.

Similar observations are associated with the celestial events (Mustonen, 2016), including that sun appears to be “higher” than in the past. Northern lights, stars, and the moon constitute an important thematic field of customary behaviour and observance.

Interestingly, the Sakha and other locals have given endemic (Mustonen, 2014) names to the 1936 and 1957 floods. Positioning the Indigenous weather observations

into a dialogue with the weather records from the Russian hydrological stations, for example in Ambarchik and elsewhere in the Lower Kolyma region, we can explore further divergence and convergence of observations.

Indigenous observations of warm weather and floods during the late 1920s and 1930s appear as weather anomalies in the weather records as well (Fig. 3). The 1936 Byybar flood corresponds to a very warm period in 1936–37 in the region. The cold winters of the 1950s and 1960s are visible, especially the 1960–65 trend. The thick river ice cannot be attributed as overall temperatures have been rather warm. The observation of a very warm year in 1972 is also less easy to confirm. But the 1967 low amount of ice seems to correspond to the warm peak in temperatures. Some divergence of the Indigenous observations from the weather records may be partly explained by the distance to the measurement stations. However, the early 1990s warming trend emerges clearly, and in the early 2000s, the trend corresponds directly with the data. In line with the local observations, a major warming peak is seen in 2007. The overall warming continues all the way to 2010s (Fig. 4).

## DISCUSSION

We have explored scientific materials, oral histories, and weather data from Andryushkino and the river Alazeya between 2005 and 2020, with some scientific measurements and oral history observations extending back to the early 1900s. As Burch (2012) and Macdonald (2000) demonstrated, oral histories are sometimes the only sources of long-term ecological change observations in those regions where scientific data are lacking. The major events, floods, warm years, and ice thickness correspond for the most part to temperature data. Accounts by Elder A.N. Yaglovski (Kurvits et al., 2009) convey the depth and wide scale of Indigenous observations from the region already from the 1940s.

In both community-based observations and scientific results, the 2007 flood emerges as a key watershed moment. If we link this to the overall topic of how Indigenous communities adapt to regional climate change (Huntington et al., 2017), we can see that the flood fundamentally altered the life in the community, forced evacuations, and was a major tangible local event. The 2007 flood made international headlines and triggered a national “Alazeya-2008” science expedition (Podgorny, 2010) to study the river and the permafrost dynamics in the region (Rosvodresursy, 2014). Given the scale and extent of the climate-induced events (Sakai et al., 2016), combined with the lowland topography that creates favourable conditions for long-term flooding, these events have been identified as key risks for Indigenous communities (Mustonen, 2009; Crate, 2017; Meredith et al., 2019). Podgorny (2010) identifies the people evacuated in the flood as the “first climate refugees” in Siberia. This event also raises profound questions of the capacity of small communities to adapt to

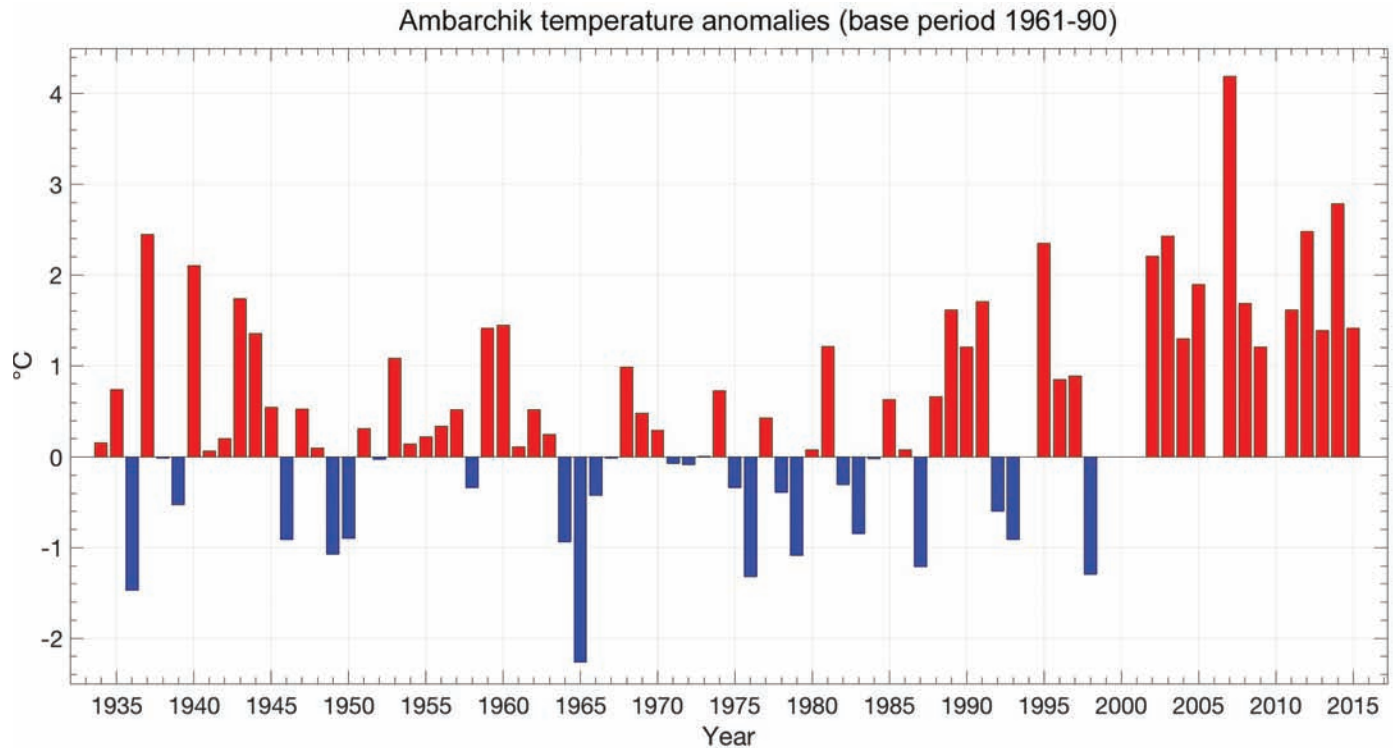


FIG. 3. Weather record trends in mean temperatures from the early 1930s until 2015. Data source is the Russian State Temperature Station, analyzed by Brie Van Dam.

present changes given their scale, unpredictability, and the marginalization of these human populations (Huntington et al., 2017). Socioeconomic changes underway emerge often simultaneously and, meshed with the weather and natural shifts, further affect the situation and capacity to adapt.

The Yukaghir and other people in Andryushkino maintain close relations with their tundra ecosystems. Traditional occupancies, such as reindeer herding, hunting, and fishing have been complemented with a new trade—digging for mammoth bones for money. This controversial action is causing rifts and reflections in the community where the reindeer herding community of Chayla has collapsed and unemployment runs high. The Sundrun wild reindeer population is one of the keystone parameters of regional change and shifts.

The Elders born in the 1940s and 1950s have conveyed profound time-space relations between nature and the Indigenous peoples in the region (see Mustonen, 2009; Mustonen and Lehtinen, 2013). While many of these oral histories are kept for the internal life of the community and families, some have been shared here to offer a view of the interconnected socioecological system and observations, such as the “two moons” event, which defy easy explanation.

Indigenous knowledge is deeper and more complex than meets the eye (Vitebsky and Alekseyev, 2014). The Yukaghir relations with their waters and their living tundra contain cosmological and mythic dimensions and interactions. It remains to be seen what kind of implications

and interpretations these will have amidst a century of immense climate change.

## CONCLUSIONS

Andryushkino and the river Alazeya have undergone major changes, which have accelerated since 1985. While the first major observations and impacts of climate change were felt in the 2000s, no one knows the full scale of transformative and landscape wide processes underway in the region. The situation of the Indigenous peoples, especially the Yukaghir, has undergone equally relevant shifts from 1642 to Soviet times, then to the post-Soviet decades, and to the present natural-resources century of the Russian Arctic.

Eurasian Indigenous and traditional communities do not have many options in terms of influencing the direct climate change impacts to their water systems. If Podgorny (2010) is correct, and we are witnessing the emergence of the “first climate refugees” for Siberia, some community adaptation may happen potentially through so-called nature-based solutions by altering, for example, fishing lakes, transport routes, and hunting territories (Mustonen and Mustonen, 2016; Huntington et al., 2017; Shadrin, in press). Permafrost events in Siberia are mostly beyond any human control and yet are significant for the floods and water cycles in the region (Wauthy et al., 2018; Post et al., 2019; Yang et al., 2020), as well as being of global significance (Meredith

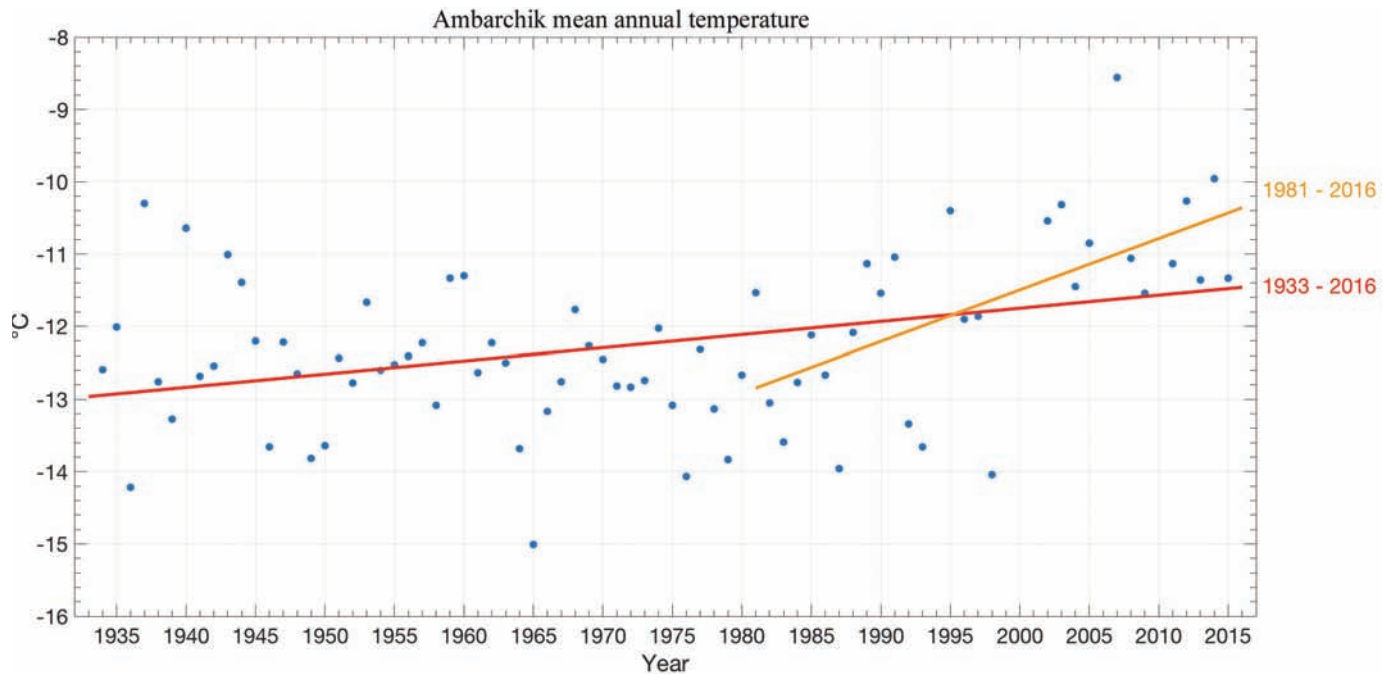


FIG. 4. Long-term trend in the mean temperatures in the Lower Kolyma. Data source is the Russian State Temperature Station, analyzed by Brie Van Dam.

et al., 2019). In the case of a basin-wide solution on the Alazeya River, the administrative division of the region resulting from the Soviet era makes concentrated responses and reliable services complex.

We have summarized 15 years of community-based work, mostly regarding environmental change in Andryushkino. The socioeconomic situation is also in a flux. Many Elders are concerned that the youth do not speak Yukaghir, even though the language has been openly permitted and partially supported since the 1990s (Filippova et al., 2013; Shadrin, 2014). While now included in the school curriculum, it does not yet manifest as a full immersion language with services, news, and public discourse fluently in the Yukaghir language.

Many Elders feel that the traditions should be upheld as they have always been in the tundra and should be passed on to children and grandchildren. Otherwise the culture could disappear completely in 100 years. Lewis (2014) discusses the attempts at cultural preservation from the 1990s when the tribal community of Chayla was founded. He says that the Yukaghir who were forcefully relocated from their previous communities into Andryushkino in 1957 had been contemplating the rebirth of the Tustakh-Sen community as a vehicle of preserving their culture, way of life, and language. In a way to respond to Elder Tretyakov's concern for the disappearance of Yukaghir way of life (Shadrin, 2014), the rebirth of this community could provide a viable restart to the tundra Vadul existence in the Lower Kolyma region.

In summary, the Indigenous peoples of the Eurasian Arctic have developed age-old relationships with the surrounding cold-reliant water systems, which are then reflected in their governance, observations, customary

law, and traditional livelihoods (Slezkine, 1994; Mustonen and Mustonen, 2016; Holmberg, 2018). The current environmental and social changes form a crucial period of uncontrolled transformation that will have lasting impacts not only on water systems but also on the local cultures and peoples depending on them.

All of these societies are fully dependent on the cryosphere for safe operation of their culture. With massive climate change impacts now affecting these cold-reliant societies, adaptation is proving to be complex, and impacts are felt both in the direct natural systems as well as cascading through the socioecological systems (Mustonen and Mustonen, 2016; Holberg, 2018; Wauthy et al., 2018; Post et al., 2019; Yang et al., 2020).

One of the most urgent forms of adaptation would be to support the rights (Berger, 1985) and survival of the Indigenous peoples in the region, for example, through divesting from natural resource uses in these pristine northern ecosystems and enabling and advancing regional restoration and resilience programmes (Holmberg, 2018). Rapid reductions in human-induced drivers of climate change would provide more options and time for the Indigenous communities to cope with the changes underway. In the words of one Yukaghir Elder from Sakha-Yakutia (Shadrin in Oral Histories, 2020), "Nature does not trust human beings anymore."

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