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Indigenous and Local Knowledge of Biodiversity and Ecosystem Services in Europe and Central Asia

- Outcomes from the Europe and Central Asia Dialogue Workshop • 11–13 January 2016 UNESCO • Paris
- Edited by Marie Roué and Zsolt Molnár
- With contributions from Tamar Pataridze & Çiğdem Adem
- Organized by the IPBES Task Force on Indigenous and Local Knowledge Systems
- In collaboration with the IPBES Expert Group for the Europe and Central Asia regional assessment

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Introduction

The Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) includes as one of its operating principles the following commitment:

> *Recognize and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems.*
>
> UNEP/IPBES.MI/2/9, Appendix 1, para. 2 (d)

This operating principle embeds the recognition of and respect for indigenous and local knowledge in all aspects of IPBES, including in the scientific and technical functions of the IPBES Multidisciplinary Expert Panel (MEP):

> *Explore ways and means to bring different knowledge systems, including indigenous knowledge systems, into the science-policy interface.*
>
> UNEP/IPBES.MI/2/9, Appendix 1, para. 15 (g)

To spearhead its work on this challenging objective, IPBES Plenary created at its Second Meeting a task force on indigenous and local knowledge systems (ILK).

The present document is a contribution to the IPBES regional assessment for Europe and Central Asia. Its aim is twofold:

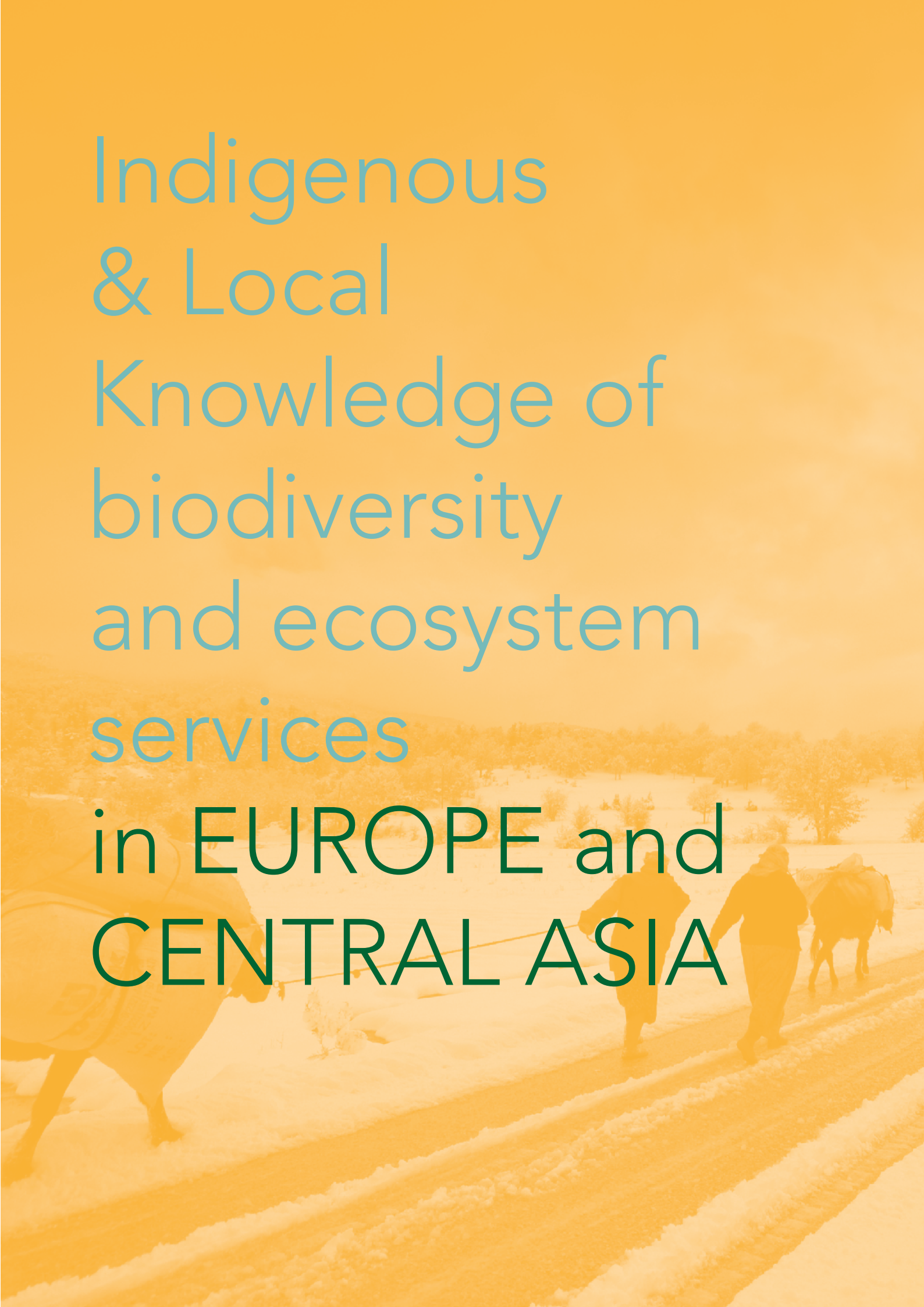
- To assist the co-chairs, coordinating lead authors and lead authors of the regional assessment by facilitating their access to indigenous and local knowledge relevant to the assessment theme.
- To pilot the initial approaches and procedures for building ILK into IPBES assessments that are under development by the ILK task force in order to test their efficacy and improve the final ILK approaches and procedures that the task force will propose to the Plenary of IPBES.

To meet these two objectives in the framework of the regional assessment, the task force on ILK implemented a step-wise process including:

- A global call for submissions on ILK related to biodiversity and ecosystem services in Europe and Central Asia;
- A selection of the most relevant submissions from ILK holders and experts;
- Organization of an Europe and Central Asia Dialogue Workshop (Paris, 11–13 January 2016) to bring together the selected ILK holders, ILK experts and experts on ILK with the co-chairs and several authors of the IPBES assessment report;
- Development of proceedings from the Europe and Central Asia Dialogue workshop in Paris that provide a compendium of relevant ILK for authors to consider, alongside ILK available from the scientific and grey literature, when drafting the Europe and Central Asia assessment report; and
- Organisation of local follow-up work sessions by the selected ILK holders, ILK experts and experts on ILK in order to work with their communities to address additional questions and gaps identified with authors at the Paris workshop.

These contributions from the Europe and Central Asia Dialogue Workshop in Paris and its various follow-up meetings, provide a compendium of ILK about biodiversity and ecosystem services in Europe and Central Asia that might not otherwise be available to the authors of the assessment. It complements the body of ILK on biodiversity in Europe and Central Asia that the authors are able to access from the scientific and grey literature.

Indigenous & Local Knowledge of biodiversity and ecosystem services in EUROPE and CENTRAL ASIA



8. The Sable for Evenk reindeer herders in southeastern Siberia: Interplaying Drivers of changes on Biodiversity and Ecosystem Services – Climate Change, Worldwide Market Economy, and Extractive Industries

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Introduction

As in many other places in the Arctic, Siberian indigenous peoples have noticed that the cold seasons take hold much later than they did 20–30 years ago, especially the first snow installation. For the Evenk nomadic reindeer herders of Southern Siberia, the different snow cover qualities either permit or threaten traditional hunting practices.

Hunting is a crucial element of the nomadic subsistence economy. A high percentage of dietary energy is supplied by wild food game, and hunting activities are also an important (if not the only) source of income for both nomads and some villagers. Modification of environmental conditions such as weather patterns or land use significantly impact subsistence economies of these indigenous societies. In southeastern Siberia, nomads and villagers have complained that the returns from sable hunting have diminished. At first, we thought that the size of the sable population has decreased, but, as we will see, the reasons are much more complex and depend on many interplaying drivers of change, from climate and environmental alterations to international geopolitics.

The Evenk make daily observations of changes in climate and the environment during their economic activities that depend on both wild and domestic fauna, flora and the land. Installation of snow cover and ice on the rivers, wind directions, flooding, animal behavior, migratory periods, and transit paths all determine the wellbeing and economic viability of the nomads. Surviving

in such an extreme Arctic climate as well as adapting to climate change and external threats is possible only through the possession of Traditional Ecological Knowledge (TEK), handed down from generation to generation, and enriched by daily observation (Lavrillier 2013).

In addition to the extreme environment, the environment of nomads and their traditional economies, societies and cultures is threatened by global changes caused by regional, national and international policies, and industrial development (Lavrillier 2013, BRISK 2012, Donahoe 2004).

The Evenk live in the taiga and practice a type of reindeer herding (specific to this biome) that is highly dependent on hunting, with small herds used for transport purposes, and food and fur game hunting as subsistence economies. Through the example of the sable hunting among Siberian reindeer herders, this paper investigates the interplaying drivers of change (climate, environmental, economic and political) at local and global scales. In the same time, it analyses the consequences on ecosystem services, the adaptive practices of the nomadic society, and their repercussions on social and ritual values. To this end, data from social and cultural anthropological fieldworks, TEK including nomads' observations, economical analysis, meteorological stations and thermo-buttons installed by nomads have been collected and combined by the authors in collective analysis.

Co-production of scientific knowledge and TEK has already been investigated in previous research, including in the Arctic. Co-production offers different and complementary sources of information that, potentially, may improve our comprehension of complex and interconnected environmental systems. However, the combination of both methods may also lead to increased complexity and uncertainties (Huntington *et al*. 2004; Gearheard *et al*. 2009). Numerous studies have shown the importance of using local observations and traditional knowledge to better understand current environmental changes and their impacts in the Arctic (e.g., Agrawal 1995 (Indigenous Knowledge); Krupnik and Jolly 2002 (North-American Arctic); Huntington *et al*. 2004; Huntington *et al*. 2005 (North-American Arctic); Gearheard *et al*. 2006 (North-American Arctic); Keskitalo 2008; Gearheard *et al*. 2009; Bulgakova 2010; West and Hovelsrud 2010).

The topic of 'climate change' is quite widely studied by anthropologists and sociologists in Canada, Alaska and Greenland (Krupnik and Jolly 2002; Krupnik *et al*. 2010; Ford *et al*. 2006, 2007; Huntington *et al*. 2004; Nuttall *et al*. 2005; ACIA 2005; Berkes and Jolly 2001; among many others). However, the research for Siberia in general is much less developed with the exception of northern Russia and western Siberia, with the leading studies of Forbes, Stammler, Stammler-Gossmann, and Vlasova carried out among the Yamal Nenets (Forbes *et al*. 2006; Forbes 2008; Stammler- Gossmann 2010; among others), among Nenets and Sami (Nuttall *et al*. 2005), among Nenets and Ienisseysk Evenk (Vlasova 2006) and particularly in eastern Siberia, except for Crate among the Yakut (Crate 2008), or Sharakhmatova among the Even and Itelmen of southern Kamchatka (Sharakhmatova 2011), a little information about the Yukaghir (Shadrin 2009) and a short report on Chukchi observation (Kavry and Boltunov 2005–2006). Southeastern and central Siberia regions have received much less attention, which was the motivation for this research.

This paper reports on one of the results of the BRISK project[4] that elaborates a transdisciplinary study of global changes (climatic, environmental, socio-economic, etc.) in the Arctic. It brings together indigenous peoples, social anthropologists, climatologists, ecologists and geographers

4 Funded by the French National Research Agency (2013–2016) and IPEV (BRISK'OBS project (2014-2017). It aims to assess environmental, economic, political and social impacts, vulnerabilities, and adaptive strategies. First, the project documents the state of the art with respect to scientific and indigenous methods of observations of global change (UNESCO, MNHN). Second, the BRISK project juxtaposes and makes comparisons at several levels. 1) It examines human–natural environment relationships in different socio-political contexts, through the comparison of different types of reindeer herding in Eurasia (UNESCO, MNHN, CEARC). 2) It considers the notion of "extreme meteorological events" from the differing viewpoints of climate scientists and indigenous peoples (UNESCO, MNHN, LMD, CEARC). 3) In order to bring together indigenous and scientific knowledge for the observation of global changes, Community-Based Transdisciplinary Observatories are jointly conceived by scientists (natural and social) and indigenous peoples (MNHN, LMD, CEARC). Of the planned 5 observatories, 4 were opened and 3 are currently active – among the Sami of Sweden (Roturier & Roué), among the Evenk (Lavrillier & Gabyshev) and among the Tuva-Tozhu (Rojo & Chondan).

together with UNESCO. More precisely, the present results come from one of the Community-Based Transdisciplinary Observatories (*further* C-B TO) of BRISK, conceived and carried out among the Siberian Evenk from 2013 by Lavrillier (anthropologist), Gabyshev (Evenk reindeer herder and hunter) and Egorova (Evenk weather forecaster).

During our research in the BRISK project in Siberia, we (Lavrillier, Gabyshev, Rojo, Claud, Chondan) have noticed that scientists and nomadic reindeer-herders have different observing methodologies and systems of thought. For instance, climatologists observe and compare trends, mean temperatures, extreme values, threshold effect, etc. by using certain variables over the long term. In contrast, reindeer herders have their own systemic knowledge and observation systems. From their daily observations made according to their indigenous knowledge and cognition, they analyse normal and abnormal modifications of their environment. As we will see, their observations and analysis of changes focus not only on one single element of the natural environment, but on the interactions between many elements (for instance between snow, and vegetal cover, and rivers, etc.) (Lavrillier and Gabyshev 2016). Our BRISK colleagues, Roturier and Roué noted that the indigenous knowledge is "highly interdisciplinary" (Roturier and Roué 2009). Even if it is complicated to bridge both scientific and traditional knowledge paradigms, both types of observation and knowledge complement each other and improve the understanding of complex environmental systems.[5]

This paper first introduces the Evenk and their perception of global climate and environment changes. The main section of the paper then presents a case study of one of the most important ecosystem services for the Evenk nomads – sable hunting – and how it is threatened by combined drivers of change. It studies the changes in snow and vegetal covers related to sable in detail, analyses the dependency of the nomads on this economic activity, and reflects on how national and international drivers of change influence this trade and, consequently, the well-being of the Evenk. Finally, it concludes by discussing the interplaying drivers of change.

8.1. Evenk Reindeer Herders/Hunters and Perceptions of Environmental Change

8.1.1. A Nomadic Dual Economy Needing Many Ecosystem Services

The Evenk are a minority indigenous people of Russia (with 38,396 individuals in 2010). In the two regions concerned by this paper, 18,232 Evenk live in Yakutia and 1,501 in the Amur region.[6] Particularly mobile, these people live in small groups spread on a vast area defined by the Yenissei river in the West, to the Sakhalin Island in the East and from the Arctic Ocean coast to the Northern of China.

The type of reindeer herding practiced by the Evenk of southern Yakutia and the Amur region is called taiga, also known as the Orochen type or Evenki type or Tungus type, according to the Russian classification (Vasilevich & Levin 1951:5).[7] It corresponds to a dual economy and a dual logic of subsistence between hunting and reindeer herding, with seasonal interplay between the two. They keep small herds of reindeer for transport purposes, but also in order to have a 'stock

5 Further discussion on the transdisciplinary methodology in the Evenk C-B TO will be published as a separate paper. Although the scientific realm may wish to develop transdisciplinarity and interdisciplinarity, the scientific publication formats do not allow publishing real transdisciplinary papers where each science can equally demonstrate methods and arguments. This will include methodological discussions, climatologic data and analysis, and TEK from Evenk and Tuva peoples.

6 Census of the Russian Federation 2010: Nationalities. Available from: www.gks.ru/free_doc/new_site/perepis2010/croc/perepis_itogi1612.htm [21 December 2015];

7 The supposed different reindeer herding "Evenk" and "Sayan" types (practiced by Tozhu, Tofa, and Dukha) (Vasilevich & Levin 1951) are more similar than different. They both use reindeer for transport purposes (sledge, pack and riding) and for milking, and only exceptionally for slaughtering (Ermolova 2003).

of meat' in case of a shortage of food game. Each species of fur game or food game is hunted following a rigid seasonal calendar and diverse strategies. Thus, hunting is carefully planned so that every species can breed successfully (Lavrillier 2005, 2011).

The collectivisation of herding and hunting was performed entirely during the 1960s in this region. Partly settled due to Communist Party policy, only approximately 30% of the population still lead a truly nomadic lifestyle. The others now live in villages and towns. However, even for villagers and some townspeople, fur and food game hunting represents an important economic input (Lavrillier 2005).

The southeastern Evenk inhabit small mountain natural forests (larch, pine, fir, birch, cedar) often with a rich under-storey vegetation of lichens, mosses and berry bushes. The continental climate is quite variable (< –50°C / + 30°C). Parts of the terrain are deeply cut by fast-flowing rivers and streams, while some of the wider valleys include extensive bogs and meadows, which provide ideal reindeer summer pastures. Scheduling subsistence activities over the landscape can only be achieved through high mobility (1500–2000 km yearly), in order to meet the requirements of both herding and hunting. This ability to move and sustainably manage the environment, despite its variability, is allowed by the profound indigenous knowledge and cognition of the environment and micro-climates.

The southeastern Evenk have been in contact with extractive industries (gold and coal mines) since the end of the 19th century, but recent developments demonstrate an important growth of industrial projects (pipelines, dams, roads and railways) that are either directly in their nomadic areas or close to them. It is important to note that Siberian peoples have no property rights on their ancestral lands.

Nowadays, the reindeer are owned by three kinds of economic units: *enterprises* that appeared after the collapse of soviet power, transforming former State farms (*solkhoz*) that give salaries for pastoral work; *family cooperatives*, also called *clan communities* (indigenous mini-companies, recognized by the Russian government and receiving a fee for each living reindeer); and *private herders* (without any administrative form nor official recognition, nor any regular income). For Evenk people from both family cooperatives and the private sector, fur and hunting (mostly sable) represent vital income.

The Evenk C-B TO is based within a nomadic community which lives across the regional frontier between the Amur region and southern Yakutia and takes place in one of the biggest Evenk nomadic areas of Russia with a surface of 7,000 km^2 and around 15,000 reindeer, led by 250 reindeer units. This is an important concentration of reindeer and human population for this kind of reindeer herding, providing for small herds (40–100 reindeer per unit) and with hunting as subsistence economy.

8.1.2. Perception of Climate and Environmental Changes: Threats to Ecosystem Services

The Evenk have been noticing climate and environmental changes for several decades, such as a rise in both winter and summer temperatures. These changes have been increasing more rapidly over the last 6–11 years, according to a social anthropological study of climate and environmental changes led by Lavrillier between 2006 and 2012.[8] Indeed, a single word sums up the main trend of weather change in the local narrative: *okollen* (in Evenk) – "it's getting hotter".

8 This research, the results of which are partly published (Lavrillier 2013), was led among diverse Evenk and Even regional groups according to classical anthropology methods (participative observation, open and semi-directive interviews, analysis of spontaneous discourses) with the deliberate choice to not mention the term "climate change". It focussed on the global perception of climate change and adaptive practices and native notion of vulnerability, as well as on the potential changes in the perception of a link between the natural environment and human society. The results from this first study were one of the reasons for building up the BRISK project and its C-B TO among the Evenk.

They have noticed that the coldest part of winter is now around two months shorter than it was 30 years ago, and it is also warmer now, therefore the snow period is getting much shorter. In addition, the Evenk link the warming with an increase in forest fires. They also link the changes in climate with changes observed in flora and wild fauna. They have noticed the extinction of some plant species (e.g. larch ivy) and animal species (e.g. some fish from the *Salmonidae* family like *Coregonus ussuriensis*, some birds), the appearance of new species of birds (e.g. birds originally native to warmer regions such as sparrows, which they previously only knew about from their school books about central Russia's fauna) and insects (e.g. new species of flies and previously unknown horseflies). The Evenk are particularly worried about a considerable increase in predator populations and the decrease of wild reindeer and elk, to a degree where there are likely to be no longer enough of them to feed the nomadic population. They also have noticed that the wild reindeer's yearly migration has changed. Therefore climate and environmental changes in southeastern Siberia do threaten the ecosystem services for the Evenk.

In addition, the Evenk are very concerned about what is happening to the domestic reindeer. They link the major and unexplained changes affecting their domestic reindeer to climate change: some reindeer are suddenly dying during very hot weather; and there is an unexpected development of parasitic illnesses (in the epidermis, the blood, the urine, the brain, the lungs and the digestive system). In addition, the newly appeared species of flies lay larvae in antlers that cause infection and sometimes lead to the death of the reindeer. Climate change also provokes an increase in the number of fires, which reduces the amount of pasture available for domestic reindeer and thus endangers their health. Moreover, the fires reduce the natural space for wild animals which forces them to migrate to other areas (often the same as the lands occupied by the nomads): this then triggers an increase in the number of predators on herding lands and the killing of the easiest prey, the domestic reindeer. The nomads have also noticed that the sable fur is not as thick as it used to be in the past.

The Evenk sable hunting case study elaborated below highlights the many interplaying drivers of change.

8.2. Sable Hunting Case Study Among Reindeer Herders – Interplaying Drivers of Change[9]

Several drivers of change threaten sable hunting – a vital ecosystem service for the Evenk – and consequently threaten their society, well-being and culture. These drivers include climatic and environmental drivers, as well as economic and political ones. See Figure 8.1 for an overview of the interplaying drivers of change, each of which is examined in more detail below.

8.2.1. Climate and environmental drivers of change on sable hunting

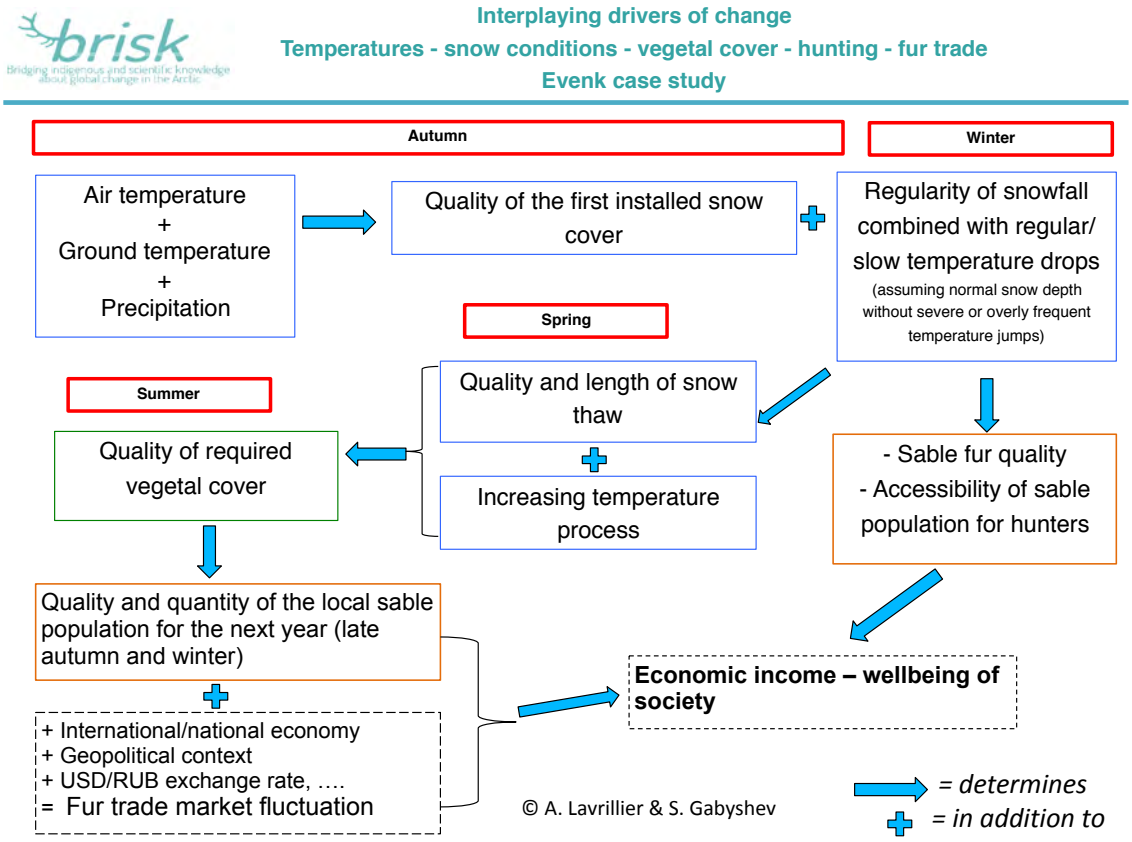
Sable hunting is highly sensitive to climate change. Indeed, in order to be sold, the sable's fur needs to achieve a specific winter state, furnished with long hair and dense internal short grey hair. This specific state of fur appears when the very winter colds arrive. There is even a specific term in Evenk for this state, i.e. *bagdargacha* meaning "it got white", and in Russian, *vykhodnoi* meaning "for party day". Sables that are not ready for sale are said to be *sikte* in Evenk, or *ne vykhodnoj* ("not for party day" in Russian). There are also nuances, like *siktevlja* in Evenk meaning "almost ready for sale", used when the back of the skin is ready (Lavrillier 2005).

9 This study is one of the results of the BRISK Evenk C-B TO of Lavrillier and Gabyshev. It developed from 2013 a transdisciplinary method that: includes hunter-herders as "observer" and "co-researcher" at all scientific steps from project planning to final analysis; produces daily observation according to climatologic and TEK interests; installs thermo-buttons according to the TEK about micro-climates; compares abnormal years; and crosses Evenk observation with climatologic data, in addition to anthropological fieldworks with mapping and detailed documentation of the TEK resulting in knowledge co-production.

Some Evenk have noticed that the quality of sable fur is decreasing and it has less dense internal grey hair – which reduces its price and consequently the household income (Lavrillier fieldwork 2014, 2015).[10]

In addition to the deterioration in the quality of the fur, climate change also threatens the sable hunting in other ways: it shortens the hunting season by delaying the installation of the snow cover and of the coldest part of the winter; it creates perturbations in the evolution of snow cover; and it acts upon the formation of the vegetal cover, that determines the distribution of the sable population.

Figure 8.1. Interplaying drivers of change in Evenk: temperatures, snow conditions, vegetal cover, hunting, fluctuations in fur trade (Lavrillier & Gabyshev 2014).



Disruptions of the schedule of snow cover installation

In the 1980s–1990s, sable hunting would start for the Evenk when all the individual animals' sable fur was ready for sale, which was the normal period of October (even mid- or late-September for some years). In more recent testimony, based on materials gathered between 1994 and 2003, a monographic dissertation about the Evenk of the same area explains that snow cover and winter are installed between 15 to 30 September. In the past, the snow cover installation was expected around mid-September, marked by a specific day – opening the sable hunting season – named the 'Semen day' (inherited from the tsarist period and a vague understanding of Russian orthodox feasts),[11] with an 'evenkisation' of this Russian term for creating a verb meaning "it installs snow cover" – *semiondaren*, literally '*it semions*' (Lavrillier 2005: 199). Nowadays, sable hunting starts

10 Nomads notice also that elk skin that was in the past entirely thick and hardwearing, is now maintaining those qualities only on the back part of the skin (Gabyshev fieldwork 2015). Several Arctic representatives have expressed their concern about the loss of skin and fur qualities in multiple oral presentations and filmed interviews (e.g. Film on circumpolar Inuit and climate change by the Inuit film-maker Zakarias Kunuk, or on the Shishmareff Alaskan coast disaster, COP21 Arctic Day, Indigenous Pavilion).

11 For this region, around the 18th-20th centuries.

at the beginning of November, when the real winter cold arrives. It becomes clear here that sable should be considered as an indicator of climate change.

The consequence of this delay is that Evenk hunters have lost an entire month of hunting, an important number of sable furs, and consequently income. The mean number of sable hunted in one month for a normal season is around 10–15 sables. This represents a loss of an important purchasing power.

Another consequence from having a much shorter hunting season is that hunters hunt in a hurry and are forced to always use the quickest method of reindeer transport – sitting on a sledge pulled by reindeer instead of riding reindeer – and to cover in one day a much bigger area than in the past.

Finally, having a too little time available for hunting, Evenk hunters adapt their hunting techniques as elaborated below, and change their schedules by starting hunting a bit before the deepest winter cold and before the entire sable population has fur ready for sale.

Sometimes, combined drivers of change (shortened winter and snow cover disruptions) also threaten the other main ecosystem service – the reindeer herding – as a consequence of the changes in sable hunting. The reduced period for hunting that forces hunters to spend almost all their time hunting during this period (instead of surveying the reindeer herd), adds to a very thin layer of snow (allowing the reindeer to move far in various directions), which then triggers a risk of losing the herd.

▶ Diverse disruptions of the snow cover impact hunting techniques

Several other environmental problems linked to the different qualities and depth of the snow cover have recurred over the past 10 to 15 years. As shown below, these problems result in multiple consequences: they threaten human access to the sables; they raise questions (for diverse reasons) regarding the presence of sable populations in certain areas; they threaten the sable access to vegetal cover; and (more indirectly), they endanger the quality of the vegetal cover.

The two techniques for sable hunting are dogs and traps. The Evenk traditionally perform the sable hunting with dogs. Dogs find the sable tracks and pursue it, followed by the hunter riding reindeer or sitting on a sledge pulled by reindeer. The dog must herd the sable in a tree, so the hunter can fire the sable (Lavrillier 2005). There is a saying in Evenk that if the snow cover reaches the level of just under the knee, this is the warning that very soon the dogs won't be able to pursue sable. It means that the hunters must hunt more intensively.

Sable hunting with dogs is much better than hunting with traps from the point of view of the Evenk. They do not like traps (which are more traditional for Russian/Slavic non-native hunters) because it allows catching too many sables, it is not 'fair play' towards the animals, it is considered as *ngalymo* – 'ritually prohibited' in Evenk, it is likely to exhaust the sable population and 'nothing will be left for the next generations' (according to an expression of the hunters themselves), and it is also associated by the Evenk as a kind of poaching. In contrast, the non-native hunters hunt sables almost exclusively with traps, installing several hundreds of traps during the season. A non-native hunter often catches around 300 sables for the season in one hunting territory. [12]

▶ Disruptions in snow cover cause problems with accessing the sable

Certain circumstances prevent access to the sables for the hunters. Lavrillier and Gabyshev illustrate with a qualitative comparison of snow periods from ordinary herders' observations and the Evenk C-B TO (E C-B TO):

- **Autumn–Winter 2015–2016** (E C-B TO): It was an exceptional winter because snow came earlier, but with two anomalies. First, a lot of snow fell suddenly from 7–11th of October

12 Evenk and non-native hunters hunt mostly in different hunting areas, defined either by official delimitation or by oral agreement.

covering the ground with 60–70cm of snow cover. Second, this snow was humid because of the warming temperature. Then, because of the temperature jumps, freezing during the nights or days, this wet snow has been transformed in a thick and hard asphalt-like layer of snow cover (*chegha* according to the Evenk snow typology). As a result, sables were running away very quickly from the hunters on the hard snow surface, while hunters and their reindeer were moving through the hard and heavy snow very slowly and with difficulty. After several unsuccessful attempts, they had to stop sable hunting with dogs on 11–12 October. Thus, they had in all, only four days of hunting with dogs (instead of between two to two and a half months in the past). At that time, only some sables' furs were ready for sale because of the warming.[13]

- **Autumn–Winter 2014–2015** (E C-B TO): This winter's snow cover was installed around 11 October with a too profound snow, under which appeared, a layer of 'snow-ice' attached to the ground and vegetal cover (*sy, si* in the Evenk snow typology). This type of snow, considered as an anomaly if it still exists in the winter, results from the thin layer of the first snow that melts during warm days, then, with abnormal rapid freezing, it is transformed into ice that encloses the vegetal cover, threatening access to it for domestic and wild animals.[14] In addition, due to the repeated warming temperatures followed by freezing, a surface layer of 20 cm was transformed into hard snow, that made transportation difficult (*chegha* and *tepama imanna* in Evenk snow typology).[15] The hunting with dogs could last until 5 November, so around 20–25 days of hunting with dogs. Some hunted sable were not/not entirely ready for sale.

- **Autumn–Winter 2012–2013** (from herder–hunter co-researcher observation): This snow period was extremely late, sable hunting started after 20 October and lasted until the end of November with dogs. The snow cover was installed on 14 October, with cold temperature and dry snow with a normal depth (just under the knee-height). It offered around 40 days of hunting with dogs. All the hunted sables were ready for sale. 2012 was a good sable hunting year (*justified by analysis Figures 8.3 and Table 8.2*).[16]

We can see here that different problems arise from 1) delays in the installation of the snow cover, and 2) the installation of the deep winter cold temperature that ensures the readiness of the sable fur for sale.

Difficulties for sables in accessing the vegetal cover

The Evenk taxonomy distinguishes two kinds of sable population: the local sables (in Evenk *biskal*), and the migratory sables (in Evenk *ngenedjeril, alanderil* i.e. 'moving'). This distinction is made by the Evenk taxonomy for many species (wild reindeer, roe deer, black grouse, snow partridge, small birds, wolves, bears).[17] It is not considered a taxon as such in Western science, although it is in the Evenk knowledge system. In contrast, the sable fur market distinguishes several sable sub-species according to biological taxonomy, but while the Evenk can identify these sub-species for the purpose of selling, these sub-species do not represent separate sub-species for the Evenk taxonomy.

The migratory sables move in small groups, moving from remote regions were snow is too deep toward regions where snow is less deep. If they find a good place (with many species of berries and field mice) they can stay a long time. They arrive in successive waves, because groups of sable are fighting for good territories and some groups can reject other groups from territories.

13 If a sable is killed that is not ready for sale, it is used by the hunters' family for sewing their own fur hats and other clothes, so it is not wasted.
14 This type of snow is known among reindeer herder peoples worldwide.
15 This hard layer supports neither human nor dogs, and crashes down. It is also difficult to go through.
16 These observations are confirmed by the temperature measurements made by the NCDC stations (used in BRISK climatologic study) and by the thermo-buttons installed by nomads. For 2014–15 and 2015–2016 it shows an important "yo-yo effect" of weather with temperature jumps of around 15°C from a day to another (Rojo).
17 Respectively: *Rangifer tarandus* L., *Cervus elaphus* L., *Tetrao urogalioides* Midd., *Lerwa lerwa* Hod., *Canis lupus albus* Kerr., *Ursus Arctos Horibillis* Ord.

Depending on the year, if the snow cover is very deep and compact, it covers and embeds the vegetal cover. The vegetal cover then becomes physically inaccessible for the sables, and sables cannot even smell/nose out berries or field mice. In this case, sables (migratory and also local ones) move away from these zones and consequently cannot be hunted by the local hunters.

▶ Disruption of the vegetal cover formation

Another disruption concerns the formation of the vegetal cover that determines conditions for the following hunting season. Thus, if the spring process is happening too early (as in the springs of 2014 and 2015), the snow cover melts out too early. Then, because of the night's and day's freezing, the frost freezes seeds and buds (in Evenk *bejipcha*) of the berries and *Pinus pumila* dies out. Thus, the following end-summer and early-autumn will not provide any harvest of berries and *P. pumila*, or it will be very poor, and during the winter sable won't have anything to eat.[18] This means that during the following year's winter, the sable population won't be present or only very few will be in these hunting areas.

We can notice here among the herders-hunters the highly systemic type of TEK in use, and the ability for climate/environmental forecasting/hypothesis for even more than one year ahead.

From the above-presented qualitative comparison of snow periods, we understand that the key criteria that determine the sable hunting are the periods of the installation of the snow (late autumn) and of the melting of the snow (early spring).

According to Lavrillier and Gabychev's analysis, the Evenk have their own system of weather/climate observation and prediction. It understands "norms", where the yearly variations are included to a certain extent, with cases in which those variations are too important or too regular considered to be "anomalies". As reflected in this paper, for the nomadic Evenk, climate has lost its logic and has become very difficult to predict.

8.2.2. Economic and political drivers of change on sable hunting

Now that we have analysed climate and environmental drivers of change, let us study the economic and political drivers of change on sable hunting. Looking at the interplay of climate change and international economical and political drivers will allow a better understanding of the consequences upon a minority society.

The political drivers are firstly the fall of the Soviet power system followed by the destruction of the economic system in which Siberian indigenous peoples were living. Accordingly, without salaries, the ecosystem services from Siberian forest became essential for indigenous subsistence (including sable hunting). Secondly, at the international level, the measures and campaigns against the fur trade have acted against the economic interests of the nomads.

The economic drivers of change are various. They include international geopolitical interests for natural resources that raise the development of extractive industries' mega projects in the lands of nomads, and reduce their pastures and hunting areas (in addition to contributing to the anthropogenic drivers of climate change). There are other economic drivers influencing the prices of sables, and consequently the sable hunting practices and the economic wellbeing of this Siberian indigenous society. These drivers include the fluctuation of the USD/RUB exchange rate (influenced by various policies) at the international level; the international fur auctions (influenced by various economic and cultural factors); and, at the local level the micro-economy network of fur merchants (influenced also by changes in Russia's economy). In addition, the Russia's inflation and rising of price is also interplaying.

18 In Siberia, the summer berries get frozen into the snow cover all during winter until springtime – offering the animals "ready to hand" food storage within the snow cover.

History of hunting for trading

Many Siberian peoples depend on fur trade for survival, especially those with taiga type reindeer herding like Evenk. It brings in the main income with which nomads buy all basic necessary goods such as flours, pasta, rice, salt, sodium, fish and meat cans and other basic goods (matches, tent tissue).

This trade was born during Russian colonisation (16–19th centuries according to the regions), when nomads were submitted to the fur tax (*yasak*).[19] Before Russian colonisation, nomads hunted mainly for food and rarely hunted the fur animals, except for clothing and decoration. The fur tax and the fur trade triggered a new hunting practice together with a new consumption of goods and food among the nomads. In contrast with other hunted animals from which almost each part is used (for food, clothing or decoration), hunters can only use the fur from the sable, while the bones and meat are not likely to be eaten, or exceptionally it is cooked for dogs (Lavrillier 2005).

The fur trade was also maintained and developed by the Soviet power for which it brought in an important income, and was maintained even after the collapse for private purposes. Between 1940–1950, in the Yakutia and Amur region, the Soviet power released a large population of sable from farms into the wild. Those farm sable have given birth to an entire sable population. It is important to note that before this introduction of the farm sable population, the Evenk hunted mostly squirrel, while sable were very rare. After the introduction, the sables have almost exterminated the squirrel population (Lavrillier 2005).

At the end of the Soviet power and the beginning of the 1990s, Evenk nomads also received income from selling reindeer spring antlers (panty in Russian), mostly for the Chinese market. But this trade was cancelled in the early 2000s due to prohibition of international export. In addition to this, because the state farms were closed down, the hunters-herders stopped receiving salaries. From this time, sable trade became a vital part of the economy for the Evenk nomads (Lavrillier 2005).

Dependency on the international fur trade

Nowadays, most of the worldwide fur production, including sable, is sold in the two St-Petersburg (Russia) and Fairbanks (Alaska) auctions. The results of these auctions in USD (with sales in January, April and December), as well as other factors, define the international and local price of the sable fur (see, for historical data, the Sojuzpushnina website).[20]

It is interesting to note that in Siberia the present commercial network through which the sables are sold and bought is the same as the one during the tsarist period and soviet power – based on the same geographical circulation of fur and the same system of credit. Indeed, in each village there is at least one local merchant that sells on credit basic food and goods at high prices to the nomads all through the year. The same nomads attempt to address their debts by "selling" their sables to this merchant who buys them at a low price. This market network includes a lot of related intermediary merchants (from small to bigger villages, from small towns to big towns, toward the St Petersburg auction) and each of them receives an important profit margin. The price difference between small villages' and big towns' merchants can be very important until it reaches the monthly subsistence wage for each sable.[21] Of course, the price difference between small village merchants and the international auction prices is much bigger, but very few hunters can reach the St-Petersburg auction (Lavrillier 2005 and 2012–2015 fieldwork).

19 During the time of Peter the Great, the fur tribute was considered to be the main resource of Siberia and was essential for state finances. During the time of Catherine the Great, it represented one third of the Imperial income (*Forsyth* 2000: 36–45, 57, 111 among others).

20 Sojuzpushnina website: www.sojuzpushnina.ru/ru/s/66/

21 Estimation by Lavrillier: in 2013, 51-60 euros difference per sable (around 4000–5000 RUB for each sable according to February 2013 EUR/RUB exchange rate). The 2013 official estimation of the subsistence wage – a good indicator of the cost of living – is between 5000–7000 RUB in Russia (http://bs-life.ru/makroekonomika/prozitochiy-minimum2013.html).

If an official enterprise has replaced the former State farms (Sovkhoz), it may practice another system, by buying the sable at a specific unique price, then readjusting the price for each sable after the results of their sales at the auction of St-Petersburg (Lavrillier 2005).

Fluctuations in the fur market: fur quality and sub-species migration

The most important criteria for determining the price of the sable is its winter state (discussed above), the absence or presence of damage on the fur, its size (independently of being male, female or old), and the quality of the fur, which is determined by several factors.

First, some sable sub-species are valued at a better price than others (see Table 8.1.):

Table 8.1. Comparative table of average prices for a sable skin (St-Petersburg auction results of the sales of January 2015). The * indicates the species is hunted in the regions concerned by this study, data from Sojuzpushnina website archive. (Lavrillier)[22]

Sub-species designations	Latin names	2015 USD average price per sable	% of one month's local subsistence wage, 2015
Sable skins farm	various	115	74%
Barguzinsky*	*Martes zibellina princeps* (Bir.)	121	78%
Jakutsky*	*Martes zibellina jakutensis* (Nov.)	50	32%
Amursky*	*Martes zibellina vitimensis* (Tim. & Nad)	33	21%
Silvery sable*	Various (with scattered long white hair)	85	54%

Some sable designations correspond to sable sub-species with biological taxonomy according to the regions of usual residence of each sub-species. Nevertheless, these sub-species are often found out of their usual region. Thus, the Evenk concerned by this study also hunt sub-species migrating from other regions. So sub-species migrations have a strong influence on the nomads' income, depending on which sub-species cross their hunting area (Figure 8.2.).

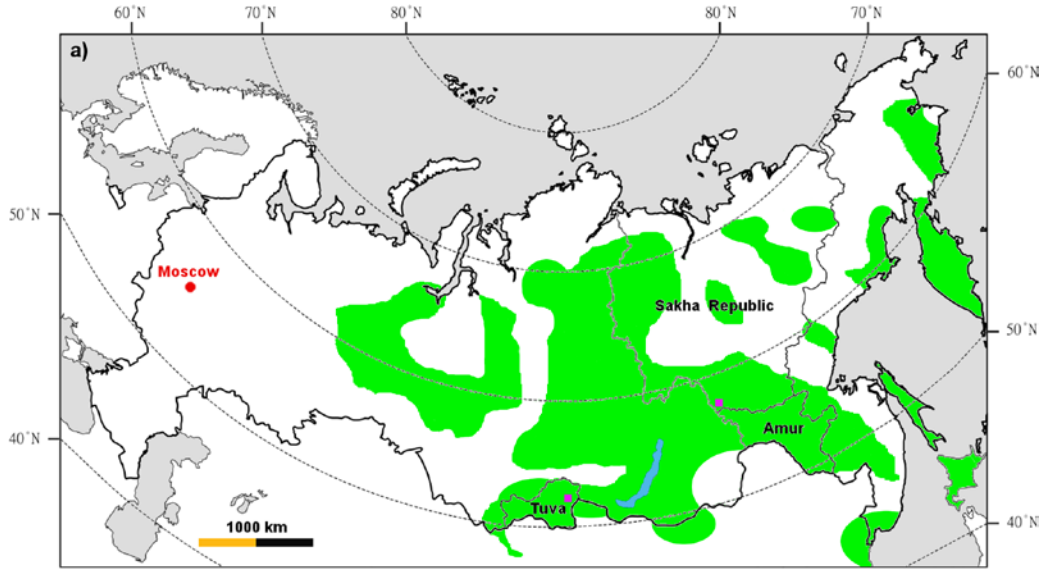


Figure 8.2. Area of repartition of Sable species from International Union for Conservation of Nature and Natural Resources (map from IUCN web site, adapted by Rojo).

22 Estimation by Lavrillier: According to the exchange rate for USD of mid January 2015 1 USD = 64,40 RUB. The local region official subsistence wage for January 2015 was 10 000 RUB (Oanda website, Lavrillier fieldwork note).

The international market economy

The sable market has many fluctuations due to various drivers in addition to those elaborated above. Even the local fur trade professionals interviewed by Lavrillier in villages and in towns struggle with identifying the main factors determining the sable fur prices ranging from the Fairbanks auction results, fashion trends, the anti-fur movement, the new market of artificial fur clothes, etc. Nevertheless, the strongest influence is attributed to the past year's sable production and to the RUB/USD exchange rate variation (see Figure 8.3.).

The economic context in the Russian Federation during the study showed dramatic political and economical changes. After a strong crisis during the nineties, the Russian economy stabilized somewhat and then has been revived. From 2008, the Russian economy experienced a strong drop in the Russian ruble (RUB), triggering a sharp rise in prices of daily consumer goods and heavily impacting the daily life of the Russian population. Exchange rates between RUB and USD started falling between August 2008 and February 2009. Then RUB has almost constantly dropped from January 2014 (33 RUB for 1 USD) until 2016 (76 RUB for 1 USD). The fur market follows this fluctuation, which affects the nomads' income.

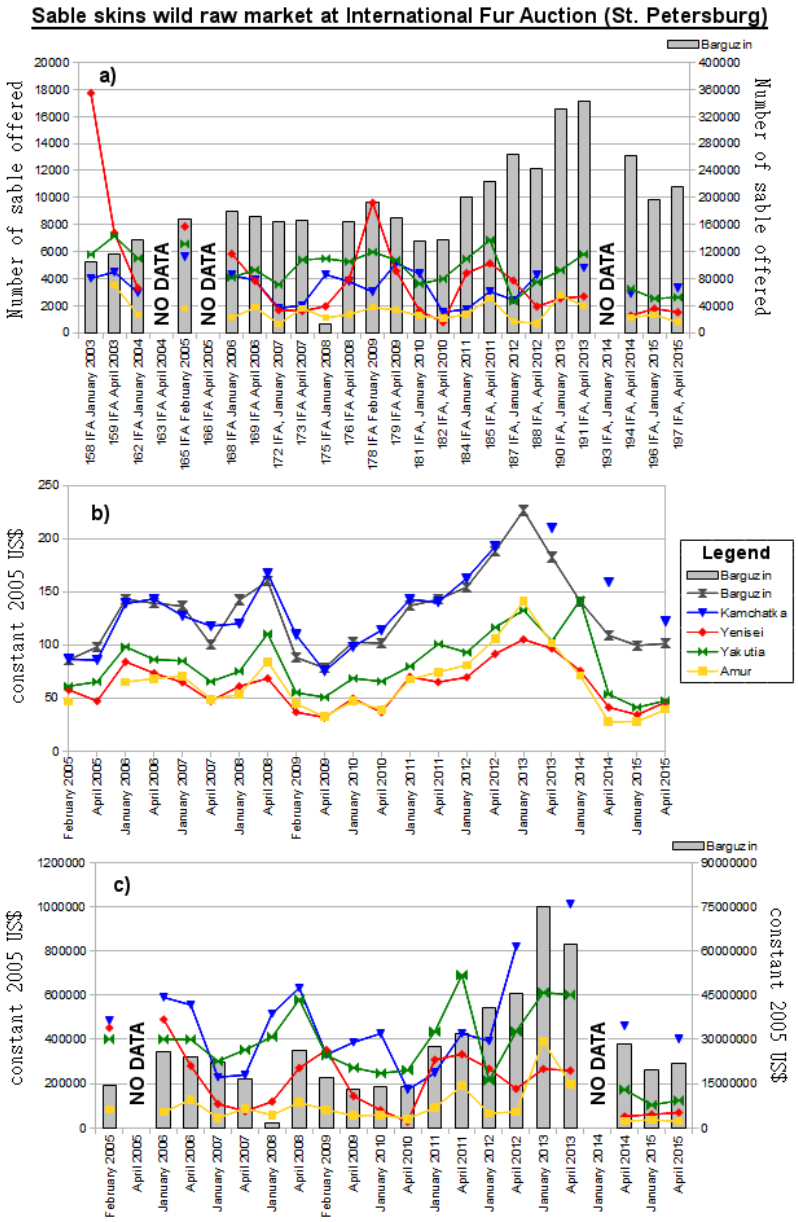


Figure 8.3. Strong Fluctuation of Sable Fur Market According to Sub-species at the St-Petersburg International Fur Auction 2010–2015. (Rojo):

▶ Geopolitical Drivers of Change

In addition, the international geopolitics influencing the international market economy are also an interplaying driver of change. For instance, the commercial banning related to the Ukrainian conflicts acts upon the exchange rate of RUB and upon the rate of inflation in Russia, and both play an important role in reliability of sable hunting as a source of subsistence income for the Evenk population in two ways: 1) as one of the elements that influences the sable prices; and 2) by determining the purchasing capacity of this nomadic society.

8.2.3. Economic Consequences and Adaptations in Sable Hunting

▶ Consequences for the nomadic household's economy

According to a fieldwork study of the nomadic Evenk household economy done by Lavrillier between 2012–2015, the yearly incomes from fur hunting are mainly not enough for covering the basic expenses of the household, or else just enough. In addition, from the beginning of the Russian crisis, the sable prices have impressively declined, which induced an important decrease of income for nomads, at the same time that the national crisis resulted in a rising cost of life (see Table 8.2.).

Let us remember, that the snow period is the only time of the year when Evenk generate incomes. Indeed, the Evenk concerned by this study are not employees of reindeer herding enterprises and do not receive any salary; some of them receive once/twice a year subsides for their family cooperative, but most of them are private reindeer herders without any other income than from hunting.

Thus, nowadays, the Evenk see their household purchasing power dangerously declining for several reasons. In the previous section we have seen that because of climate change they lost an entire month of hunting sable with dogs and face new difficulties of access to sable. We have now seen that the decrease of the sable price and the strong inflation in Russia add an additional pressure on household economy. The inflation is reflected by the abrupt augmentation of the subsistence wage (in 2015 it changed from 10,000 RUB in January to 15,000 RUB in December) and the impressive rise of prices.[23]

As a consequence, an overwhelming majority of nomads are very often indebted to the hilt among the local merchants and, for the pensioner (thanks to their regular small pension) with credits in banks.

23 The prices of food are growing up very impressively. For instance, in January 2015 sugar was locally 60 RUB/kg, rising to 80 RUB/kg in December; flour was 30 RUB/kg and became 40 RUB/kg.

Table 8.2. Comparative table of income/outcome from fur and food hunting for trading among nomadic Evenk (Yakutia-Amur) (from fieldwork analyses, exchanges rates, official sites for subsistence wage). (Lavrillier)[24]

Hunting season	Sable hunting	Sable price per animal USD	Meat hunting	Meat price per animal USD	One subsistence wage USD	Beneficial USD (1 year)	Uses of all incomes (address debts + new purchase)
2015–2016	very bad	53 (4000 RUB) (bad)	bad	458	196 (15000 RUB)	NONE	Address debts + purchase basic food & goods next 5 months
2014–2015	bad	39 (2500 RUB) (very bad)	good	543	155 (10000 RUB)	1400	Address debts + purchase basic food & goods for next 10 months
2013–2014	very bad	121 (4000 RUB) (bad)	very bad	1051	285 (9400 RUB)	NONE	Partly address debts
2012–2013	good	200 (6000 RUB) (good)	medium	1166	200 (6000 RUB)	8 500	Address debts + purchase basic food & goods for next 14 months + expensive items (e.g. snowmobiles)

▶ Changing hunting techniques – threats to social and ritual values

A general analysis of consequences of climate change among the same Evenk highlighted adaptive practices in many domains, both pragmatic and symbolic, inducing other changes (2006-2012). For instance, some adaptions of hunting and herding practices have given rise to changes in social organisation. Also, there have been some changes in religious practices, such as modification of ritual gestures (Lavrillier 2008), as well as the creation of new rituals and changes in the perception of the human–natural environment relationship (Lavrillier 2013). Our present sable hunting case study shows new adaptive practices as outlined further below.

First, because of the bad sable hunting seasons, Evenk are sometimes forced to also hunt wild reindeer to sell, to balance the loss in order to get sufficient income for basic food and good purchases.[25] It follows that the wild reindeer meat is nowadays reserved mainly for selling, and only a small amount is left for personal consumption. This amount (much smaller than in the past) is now shared within a much narrow kin network than in the past. This creates some socio-familial tensions between nomads and their kin living in the village, which do not necessarily understand the situation of the nomads and their obligation to hunt sustainably.

Second, the Evenk have changed their sable hunting techniques, from hunting sable mainly with dogs, to hunting mainly with traps. From 2000–2005, step-by-step, hunters started to use more and more traps. Even if Evenk do not like sable hunting with traps for several reasons (elaborated above), they are forced to use them since they have a shorter period for hunting.

Indeed, hunting with traps requires less effort from reindeer transportation. It is enough to make a round once for installing the traps, then to check on the traps 1–2 weeks later. Thus, even if snow

24 The USD/ RUB exchange rate in mid January for 2013 – 30,00, for 2014 – 33,28, for 2015 – 64,40, and for 2016 – 76,37 (Oanda website); average selling price per animal at local villages and town merchants; regional subsistence wages is for January of each year. It is in January that the Evenk make most of their purchases and sell the biggest part of their sable and meat production.

25 The reindeer meat market is really underdeveloped and many hunters struggled with finding buyers. Nevertheless, there is no waste since, due to the indigenous rules of sharing, unsold meat is equally shared among close kin and friends.

is very deep, it is not too hard to go through once for installing the traps (and creating by this a "snow-road"),[26] then to come back along this already made snow-road for checking on the traps. In contrast, sable hunting with dogs obliges the hunters to create each day a new road and to cross fresh snow – which is either impossible, or very exhausting for reindeer in case of deep snow.

This change of hunting techniques contradicts the social and ritual values of the Evenk. Nevertheless, first the Evenk have no other choice; second, they use traps only when hunting with dogs becomes impossible; and third, they have found a compromise by installing a limited quantity of traps with a maximum of 30–50 per hunter to ensure sustainable hunting. This makes an important difference in comparison with the local non-native hunters that install several hundreds of traps.

Conclusion

Firstly, we understand that it is essential for hunters to understand, and to be able to predict, the evolution of the snow cover, as well as to know in detail the biodiversity of each small area of their huge nomadic space. The Evenk system of environmental observation and prediction is based on their knowledge about the interactions between elements of the environment. It is crucial to be able to predict changes in the vegetal cover, which is possible only by knowing (among other things) the interactions between snow cover and vegetal cover. The combined knowledge about evolutions of both vegetal and snow covers allows predicting the potential position of the animal population in the different areas, in order to adapt hunting for survival.

Secondly, we see here that climate change leads to specific environmental changes, which in turn create changes in traditional economic practices, which then triggers socio-economic problems among a population that needs to adapt its hunting techniques, and make compromises between economic needs and respect of their social and ritual values.

Thirdly, this study demonstrates that Siberian peoples (as do many other Arctic indigenous peoples) face climate change in concert with other interplaying global factors. In addition to climate change, other drivers interplay upon the Evenk society including political drivers and economic ones, at different scales. Political drivers include the destruction of the economic system in which Siberian indigenous people were living, which has led to the ecosystem services from Siberian forests, including sable hunting, becoming essential for indigenous subsistence. Economic drivers include fluctuations in the international exchange rate, the outcomes of international fur auctions, and, at the local level the micro-economy network of fur merchants (influenced also by changes in Russia's economy).

We can see here, therefore, at both micro and macro scales, the interplay of the many different drivers of change, linking small indigenous communities of nomadic hunters-herders to the international economic and political realm.

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26 The Evenk create several "snow-roads" that they regularly use during the entire snow period, by traveling once or twice along the same paths, so the snow will be hardened by the weight of the sledge and the freezing, which makes transport much easier.

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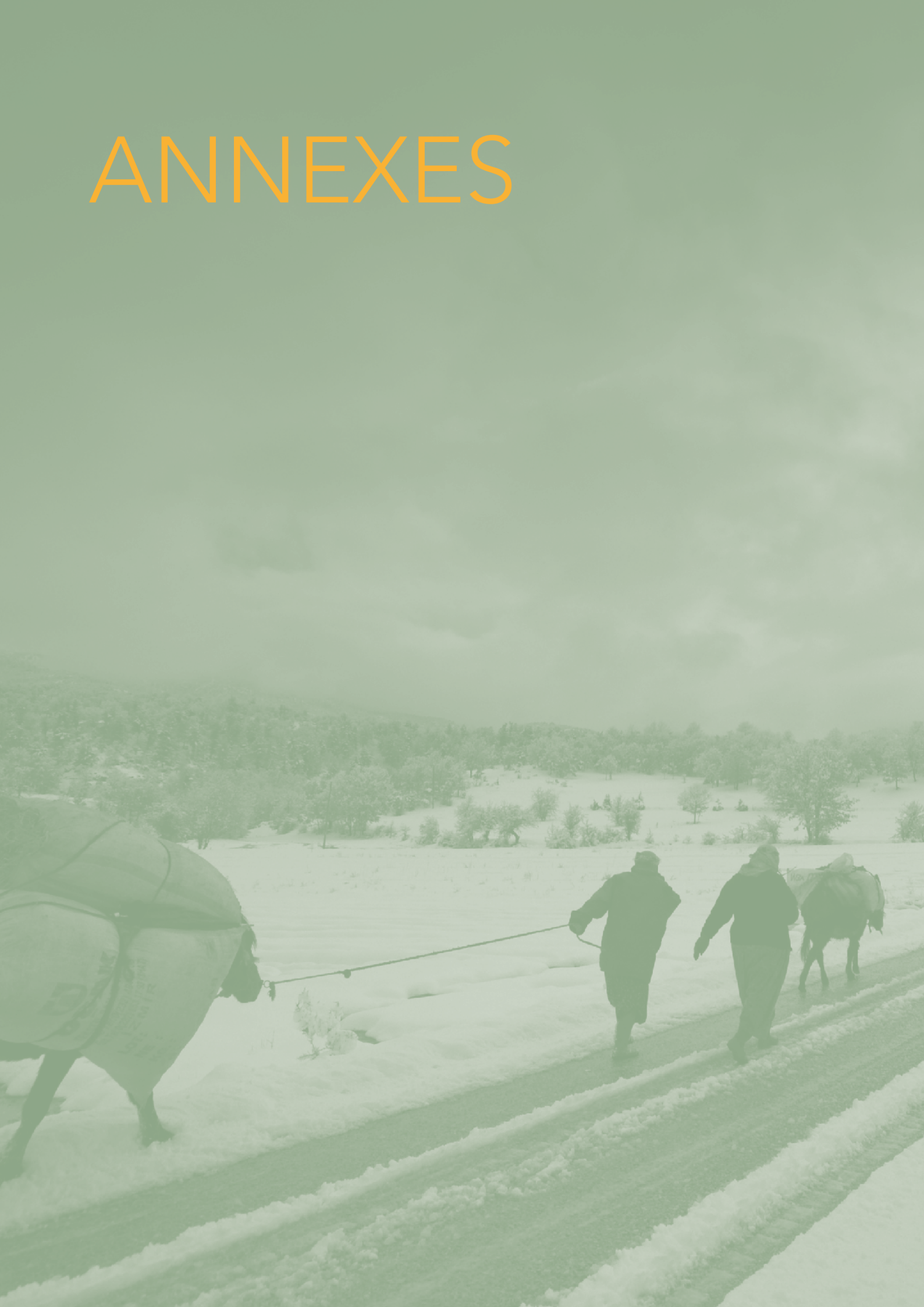
ANNEXES



ANNEX 2: Author bionotes

Mats-Peter ÅSTOT is a reindeer herder from the Sami community of Sirges in northern Sweden. He is member of the board of his community and is actively involved in the BRISK research program aiming at improving the dialogue between scientific and indigenous knowledge. He is also a recognised carpenter, having received awards for building traditional Sámi dwellings in the Laponia World Heritage site.

Daniel BABAI studied biology and ethnology and cultural anthropology at the University of Pécs, in Hungary. He works at the Research Centre for the Humanities, Institute of Ethnology (Hungarian Academy of Sciences) since 2007. He finished his PhD in 2014 (Botanical and ethnoecological investigation of mountain vegetation in Ghymes (Eastern Carpathians Romania)). He is interested in ethnoecological knowledge and extensive grassland management.

Sándor BARTA was born in 1982 in Karcag. Married, has a daugther. He was born into a herder family, and learnt his herding skills from his father. Since the finishing of the secondary school he has been working as a herder. Sándor herds on and thus manages salt steppes and marshes of the Hortobágy National Park. He is one of the participants of the film "Traditional ecological knowledge of Hungarian herders".

László DEMETER: I was born in The Ukrainian Soviet Socialist Republic, in 1986. In 2009, I became qualified as a Specialist in Biology and Geography, receiving my specialist degree from the Transcarpathian Hungarian Institute. Before I became a researcher, I worked as an English teacher in a Ukrainian primary school. Currently, I am at the early stage of my research career and am doing my PhD at the University of Pécs, Hungary. I am interested in traditional forest-related knowledge and forest management.

Lajos ELEKES: Cattle herder, born in 1964. He learnt his herding skills from his age of three, working with his herder grandfather and shepherd uncle. He has been a full-time herder since 1990, mostly working with cattle but also with horses and sheep. He herded the gray cattle herd (270-390 heads) of the Kiskunság National Park at Pusztaszer on sand, loess and salt steppes and marshes. He is employed by the Ópusztaszer Heritage Park at present, but keeps cattle, sheep and horses at his farmstead. He loves and respects Nature very much.

László ENGI: Cattle herder, born in 1975. He has been a herder for 10 years. He is working on the salt steppes of the Csanádi-puszták Protected Area, which is part of the Körös-Maros National Park. He herds the Hungarian Grey Cattle herd of the NP (150-300 cattle). He learnt his herder skill from older herders and own experience. His hobby is ornithology.

Tibor FEGYVER: Cattle herder, born in 1972. Herding has been his main job for 20 years, but he learnt his knowledge in his childhood from his herder father. He is also working for the Körös-Maros National Park, with its grey cattle herd of 150-300 heads. He likes reading a lot while herding. He is very observant toward nature and regularly writes poems about it.

Semen GABYSHEV is an Evenk reindeer herder and hunter with 26 years of experience in Amur region and Yakutia (Russia). Confirmed holder of the Evenk TEK and language, associate member of the CEARC, he is implied from 2012-2013 in scientific projects as an indigenous co-researcher: BRISK on environmental and climate changes, POLARIS on tourism and cultural and natural patrimony, PARCS on perception of pollution.

Anita HEIM: She completed her MAppSc in Protected Area Management at James Cook University, Australia and her MSc in Ecology at Eotvos Lorand University, Hungary. Currently she is doing her PhD studies in agroecology at the University of Helsinki on the topic of "Drivers of food and nutrition security among a Sub-Saharan indigenous group". In her research she takes a transdisciplinary approach by combining ecological, social and nutritional sciences with cultural knowledge systems to unwrap the complexities of the drivers of food choices, and the connections of landscape to nutrition among the San people in Namibia.

Cosmin IVAȘCU: PhD student at the Babeș-Bolyai University, Faculty of Biology and Geology with research interest in ethnoecology, ethnobiology and historical ecology. Current research is focused mainly in Romania and the Romanian Carpathians. Starting from 2014 and ongoing he spent over 70 days of fieldwork documenting the traditional ecological knowledge of the locals from Ieud village, county Maramures, Transilvania region.

Sezdbek KALKANBEKOV is a traditional knowledge holder and a guardian of Kochkor Ata sacred site located in Kochkor district of Kyrgyzstan. This sacred site is one of the best known sacred sites in Kyrgyzstan which attracts pilgrims from all over the country and beyond.

József KECSKEMÉTI: Herder, sheep farmer, born in 1977. He has been engaged with shepherding since his childhood, almost born into it. His masters, his father and uncle were shepherds too. He owns 160 sheep, and grazes them on sand and salt grasslands at Kunadacs inside the Kiskunság National Park.

József KIS: Cattle herder, born in 1982. He learnt his herder knowledge in his childhood working with his grandfather and other herders. He has been a full-time herder since 2002. He mostly worked on the salt steppes of the Horbotágy National Park. He is now working at Fábiánsebestyén (Csongrád county), herding 250 cattle. He also graduated as a conservation manager in 2011 at the Debrecen University. His main interests are conservation-oriented traditional grazing and pasture management.

Levente LAJKÓ: Shepherd, sheep farmer, born in 1973. He owns and rents pastures at Üllés, and grazes 300 sheep on dry sand pastures. He has been farming for 12 years. He learnt his herding skills from old herders, own experience, books and internet.

Alexandra LAVRILLIER: Associate Professor in Anthropology at the CEARC (Cultures, Environments, Arctic, Representations, Climate), (UVSQ) of University of Paris-Saclay. Fluent in Evenki, she performed around 9 years of fieldwork on hunting, reindeer herding, landscape management, representations of the natural environment, adaptations brought by postsocialism, the market economy and climate change as well as shamanism among Evenki, Even and Yakut.

János MÁTÉ was born in 1980 in Debrecenben. His parents were herders, he has been herding since the age of 10. Married, has a son and a daughter. He learnt his skills from his father, grandparents and oncle and worked as shepherd or cattle herder. János herds on and thus manages dry and wet meafdows of the Kiskunság National Park. He is one of the participants of the film "Traditional ecological knowledge of Hungarian herders".

Ábel MOLNÁR was born in 1991 in Miskolc. His parents are botanists. He learnt agriculture at the Szent István University, Gödöllő (agri-environmental topics as BSc and general agriculture as MSc). He is interested in habitat mapping for nature conservation and photo documentation of traditional small-scale agriculture of mountain farmers in the Eastern Carpathians and steppe herders in the Hungarian Plain.

Lars-Evert NUTTI is a reindeer herder from the Sami community of Sirges in northern Sweden. In addition to his herding activities, he is actively involved in the dialogue between the forestry sector and reindeer husbandry, engaging regularly in dialogues at the national level. He has become an expert in forestry – reindeer husbandry interaction in Sápmi.

Jakob NYGÅRD is a reindeer herder who heads the Sami reindeer herding community of Sirges based in Jokkmokk, northern Sweden. He is a board member of the Laponia World Heritage site, and is particularly active on social networks sharing the joys and difficulties of being a reindeer herder.

Laszlo RAKOSY: Professor, Director of the Department of Taxonomy and Ecology of the Faculty of Biology and Geology, Babeș-Bolyai University, with main research interests in Lepidopterology, zoogeography, taxonomy, biodiversity conservation of Transylvanian cultural landscapes, cultural ecology.

Samuel ROTURIER is an Associate Professor in restoration ecology at the AgroParisTech/Paris-Saclay University. He has been working for 10 years on reindeer winter pastures in northern Sweden together with forest companies and Sami reindeer herding communities. His research interests include the restoration of socio-ecological systems and indigenous and local knowledge systems in boreal regions.

László SÁFIÁN was born in 1969 in Debrecen. Married with one daughter. He is a traditionally working shepherd having ca. 500 merino-type and crossed sheep. He works with his own and his brother's family. He learnt his herder knowledge from his father. László herds on and thus manages sand steppe pastures of the Hortobágy National Park. He is one of the participants of the film "Traditional ecological knowledge of Hungarian herders".

Aibek SAMAKOV is currently a PhD student in anthropology at the University of Tübinhen (Germany) and holds a Master's degree in Natural Resources Management from the University of Manitoba (Canada). He also has been working for Bishkek-based Aigine Cultural Research Center (Kyrgyzstan), which focuses on research as well as applied projects related to traditional knowledge and sacred sites. Aibek is interested in human dimensions of natural resource management, sacred sites and environemntal anthropology.

Dávid Pelé SÜTŐ was born in 1990 in Debrecen. He studies Visual Anthropology at the Miskolc University. His hobby is folk dancing. His first film is about a roma family, the second is a film for IPBES: "Traditional ecological knowledge of Hungarian herders". He has been studying the culture of the herders at the Hortobágy; his MSc topic is "Recent image change of the 'puszta'".

János SZABÓ: Shepherd, born in 1977. He was born into a herder family, his father and grandfather were shepherds too. Even during his military service he worked as a military shepherd. He has been working as a herder since 1992 in many regions of Hungary, herding sheep, goats and cattle on many different types of pastures. He has a wide experience on livestock's grazing preference and nature. He works with 300 goats on a sand pasture near Győr at present.

Anna VARGA: Traditional ecological knowledge's snippets and traditional value system was given for me by my family and ancestors through their traditional rural lifestyle. I am the leader of The Hungarian Association for Land and People NGO science 2006. Our aim was to understand the traditional connections between land and people in the Carpathian-basin. As a student I started to research silvopastoral systems in the Carphation-basin. I continued this research during my PhD study and I still work on traditional silvopastoralism as an assistant research fellow of the Traditional Ecological Knowledge Research Group, Institute of Ecology and Botany, Hungarian Academy of Sciences. I participate at the AGFORWARD project,which focus on agroforestry systems in Europe.

Maxence ROJO is a PhD student in anthropology and climatology at the CEARC. His studies (funded by BRISK project and the Laboratoire Météorologie Dynamique) crosses perspectives in climatology and social sciences in various frames, like polar lows and local economics. In addition to trans-Siberian analysis of climatologic data, he had also conducted fieldworks in Tuva Republic (Russia) among townspeople, villagers et various herders.

SCIENTIFIC EDITORS

Zsolt MOLNÁR: Botanist, ethnoecologist, born in 1966. Main fields of study: historical landscape ecology of the Hungarian Plain, traditional ecological knowledge and methodology of habitat mapping. Founder and leader of the Traditional Ecological Knowledge Research Group of the Hungarian Academy of Sciences. He studies botanical, vegetation and landscape historical knowledge of steppe herders and mountain farmers in Hungary, Romania, Russia and Mongolia, and how this knowledge could be used in nature conservation. Author of >130 scientific papers and author or editor of 12 books.

Marie ROUÉ is a senior researcher in anthropology at the French National Centre for Scientific Research (CNRS) and the National Museum of Natural History (MNHN). She is currently a member of the Multidisciplinary Expert Panel and the Indigenous and Local Knowledge task force of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Her research interests include the indigenous knowledge and knowledge co-production amongst Arctic peoples. She has worked with Cree First Nations and Inuit in Canada and Alaska, and with Sami in Norway and Sweden since more than 45 years.