EALÁT

REINDEER HERDING, TRADITIONAL KNOWLEDGE AND ADAPTATION TO CLIMATE CHANGE AND LOSS OF GRAZING LAND

ARCTIC COUNCIL

Ассоциация «Оленеводы Мира»
Association of World Reindeer Herders

A PART OF THE IPY EALÁT CONSORTIUM. THE EALÁT PROJECT (IPY # 399), «REINDEER HERDERS VULNERABILITY NETWORK STUDY: REINDEER PASTORALISM IN A CHANGING CLIMATE. AN ARCTIC COUNCIL SUSTAINABLE DEVELOPMENT WORKING GROUP PROJECT LED BY NORWAY AND ASSOCIATION OF WORLD REINDEER HERDERS (WRH).

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A project led by Norway and Association of World Reindeer Herders (WRH) in Arctic Council, Sustainable Development Working Group (SDWG).

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Front cover photo by Ellen Inga Turi: Young nenets reindeer herder Vita Seretetto, Brigade 8 in Yamal Nenets AO, Russia, expressing that reindeer herding is a human coupled ecosystem.

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PREFACE

The IPY EALÁT project (EALÁT: Reindeer herding, traditional knowledge, adaptation to climate change and loss of grazing land), led by Norway and Association of World Reindeer Herders (WRH) in Arctic Council, Sustainable Development Working Group (SDWG) was initiated in 2006. The project has been coordinate by International Centre for Reindeer Husbandry (ICR), Kautokeino, and by Sami University College (SA) also in Kautokeino, Norway, and was designed to gather information about the environmental changes which Arctic reindeer herders are facing and to give concrete examples of herders' traditional knowledge leading their adaptation to changing conditions, e.g. traditional uses of grazing land. In all, 21 workshops have been held in local herding communities in the reindeer herding regions of Norway, Sweden, Finland, and Russia in 2007–2011 and recently in Canada. The challenge of EALÁT is to transfer herders' knowledge into action for sustainable development of the rapidly changing Arctic. The legacy of IPY EALÁT work has therefore developed into local information centers for different types of reindeer husbandry in Russia, as well as the UArctic EALÁT Institute - University of the Arctic Institute for Circumpolar of Reindeer Husbandry. This report is produced for the 7th Arctic Council Ministerial Meeting in Nuuk, Greenland, as a Sustainable Development Working Group (SDWG) executive summary report. The report builds on information collected during IPY EALÁT including the community-based workshops, and includes key findings and recommendations. The report also is based on the IPY EALÁT scientific report (Magga, Mathiesen, Corell and Oskal in prep.). A 30-minute documentary EALÁT – People and Reindeer in a Changing Climate has been produced and is delivered with this report. We acknowledge the Russian Association of Indigenous Peoples of the North (RAIPON), the Saami Council (SC) and the Reindeer Herders Union of Russia (RHUR) for partnership and fruitful cooperation and more recently the Arctic Athabaskan Council (AAC), the Gwich'in Council International International (GCI) and the Inuit Circumpolar Council – (ICC) for holding a workshop as part of the Norway-Canada High North Dialogue in Canada. The Arctic is the home of indigenous peoples like reindeer herders and is now changing rapidly. The ambition of EALÁT and this report is to contribute to increased cooperation between Arctic nation states and indigenous peoples to secure future sustainable development in circumpolar north and maintain a highly resilient society for reindeer herders.

Ole Henrik Magga, Svein D. Mathiesen, Robert. W. Corell and Anders Oskal

KEY FINDINGS

1. Climate and socio-economic change are now evident across the Arctic, and is particularly evident in reindeer herding cultures and in their traditional areas.

2. Global and regional scenarios project dramatic changes in temperature, precipitation and snow conditions in the key areas for reindeer herding and in social-economic changes for reindeer herding communities in the Arctic.

3. Indigenous traditional knowledge, culture, and language provide a central foundation for adaptation and building resilience to the rapid changes in the Arctic. Reindeer herding cultures and traditional knowledge are nested within and inevitably affected by institutional governance, economic conditions and other regulatory practices and conditions.

4. Both scientific and traditional experience-based knowledge, knowledge transformation, education and training of future leaders and others are key factors for the future sustainability of reindeer herders' societies and their adaptation.

5. Degradation of pasture lands combined with the consequences of a changing climate present substantial challenges to the future of reindeer husbandry.

6. Engaging reindeer herding youth directly in herding practices and providing enhanced education is a key factor in the future sustainability of reindeer husbandry and its cultural foundations.

7. A vision of a self-sustained and adaptive reindeer community in the circumpolar north is increasingly faced with rapid climate change, regulatory challenges, and altered or degraded pasture lands. The future for these communities is dependent on reindeer herders' use of traditional knowledge and integrating scientific knowledge in implementing risk spreading through diversity in social organization, economy and through understanding biological diversity.

8. The reindeer husbandry communities of the circumpolar north are guided by three cultural constructs within which they seek to: (1) Control their own destiny, (2) Maintaining their cultural identity, and (3) Be able to live close to and rely on nature for their livelihood and well-being.

Photo: Svein D. Mathiesen, EALÁT

INTRODUCTION

Reindeer husbandry is a traditional livelihood in Eurasia, carried out by more than 20 different ethnic indigenous Arctic peoples in Norway, Sweden, Finland, Russia, Mongolia and China, involving close to 100 000 herders, 2.5 million semi-domesticated reindeer, and covering some four million square kilometers of pastures. The traditional livelihood of reindeer pastoralism represents a model of sustainable exploitation and management of northern terrestrial ecosystems based on experience accumulated over generations, conserved, developed and adapted to the climatic and political / economic systems of the north. It is therefore necessary that any vision of sustainability related to the Arctic reindeer herding areas must take account of the knowledge and lessons learned by those who practice reindeer husbandry and related subsistence activities in the region. Reindeer herding peoples have lived and worked across wide areas of Eurasia since time immemorial. Recently Nenets reindeer pastoralism in the Yamal Nenets Autonomous Okrug (hereafter referred to as YNAO), Russia was dated to be more than 2 000 years old (Fedorova, 2003). The YNAO in western Siberia is one of the largest reindeer husbandry regions in the world with about 600 000 reindeer and over 14 500 people who practice nomadic reindeer husbandry. In Norway there were about 180,000 reindeer in Finnmark where around 1 500 people are active reindeer herders. In Chukotka there are 200 000 reindeer and approximately 1 500 herders, while in the Nenets Autonomous Okrug there are approximately 160 000 reindeer and according to official statistics there are 912 herders. Finally, in Sakha (Yakutia) there was 180 000 reindeer and 2 252 herders in 2010. During the International Polar Year (IPY) reindeer herders' societies across Eurasia have been engaged in knowledge documentation and production through the EALÁT project. The project has focused on Western Finnmark in Norway and the Yamal peninsula in the YNAO but also included community based workshops which have been held in the Republic of Sakha (Yakutia) in Russia, in Finland and Sweden, the Nenets Autonomous Okrug, Chukotka and most recently in Inuvik in Canada.

Reindeer herding represents a human-coupled ecosystem which has developed a historical high resilience to climate variability and change (Turi, 2008). The explanation to this is that reindeer herding is a system based, as a rule, on continuous change due to the practice of seasonal migrations and day-to-day changes. The core survival strategy of reindeer communities is based on knowledge about how to live in a changing environment. The concept of «stability» is foreign in the languages of reindeer herders. Their search for adaptation strategies is not connected to «stability» in the normal meaning of this word, but instead is focused on constant adaptation to changing conditions. (Johan Mathis Turi, World Environmental Day 2007). The basic needs for the animals are access to food and water, space for rest and shelter and space for physical activity. A cycle through the year, through a season and through day-night periods includes variations like grazing, resting, rutting, giving birth to calves, snowing, melting of snow, hot weather and

Figure 1. *The distribution of reindeer and reindeer peoples in Eurasia.*

prevalence of predators and insects. In additions there are the activities which derive from human needs for organization of reindeer herds such as identifying animals, ear marking, slaughtering, castration, separation, moving of herds and training of animals for transportation and other needs. In addition to the handling of herds and individual animals, there are many detailed techniques a reindeer herder needs to master. All these elements are dependent on conditions in nature and hence are exposed to multiple changes.

Indigenous peoples in the Arctic now face major challenges related to changes in their societies, and a changing northern climate, which might be the first indications of coming major global changes effecting Arctic societies. IPY EALÁT was originally initiated by the Association of World Reindeer Herders (WRH) to address the challenges of climate change and the degradation of pastures, in order to maintain and develop robust reindeer herding societies in the circumpolar north in the future. EALÁT is a multicultural and multidisciplinary vulnerability study of reindeer herders' society and projected climate change. The term *ealát* is from the language of the indigenous Sámi people of Fennoscandia, and means *«something to live on (especially for reindeer)*, such as *(sufficient) pasture»*. This word is related to the term *eallu*, which means *«herd»*, while the origin of these terms derive from the word *eallin which means 'life'*. Thus pasture is the foundation for the reindeer herd, and reindeer herds are the foundation for the lives of indigenous reindeer herding peoples throughout the circumpolar North. A deep understanding of and insights into the sustainability and resilience of reindeer herders' societies' is often embedded in their knowledge, languages and traditions. There are already many indications that projected changes in future climate in Finnmark, Yamal, Sakha and Chukotka will influence reindeer and reindeer herding. Changes in climate is likely to modulate the availability of forage, especially in winter due to changing snow conditions, but may also influence the growth of plants and lichen and effect the balance between different species which are important to reindeer. Climate driven modulation of the forage supply will have both direct, short term effects and indirect, lagged and persistent effects on reindeer herding. Furthermore herders' ability to adapt to the consequences of climate change is influenced by a variety of non-climate factors influenced by governance and socio-economic change.

IPY EALÁT has been a consortium of different activities and partners in the circumpolar north including research, documentation of traditional knowledge, education, learning, outreach and information. Arctic indigenous peoples' insights and understanding, as they are documented by EALÁT and other related projects such as the SIKU (Sea Ice Knowledge and Use) project organized by the Smithsonian Institution, will contribute to more human, holistic and multidimensional perspectives on the Arctic (Krupnik, *et al.* 2010). The results and analyses provided will bring new and important perspectives to sustainable management, research and teaching in Arctic societies. This Summary report to Sustainable Development Working Group (SDWG) in the Arctic Council and is based on information from 21 community based workshops in reindeer herders' societies' throughout the Eurasian north and Canada, documentations, new insights and results from the IPY EALÁT scientific report comprised of 16 different chapters (Magga, Mathiesen, Corell and Oskal *in prep*) and the IPY EALÁT consortium report 2007–2011. IPY EALÁT is a following up of the Arctic Council report Arctic Climate Impact Assessment (ACIA 2004) chapter 17 (McCarthy *et al.* 2004) and uses the previously developed vulnerability framework for climate change and reindeer husbandry (Tyler *et al.* 2007).

I AM NOT TOO CONCERNED ABOUT CLIMATE CHANGE IF IT IS DUE TO NATURE ITSELF. BUT IF IT'S DUE TO PEOPLE, THAT PEOPLE HAVE BEEN DESTROYING NATURE, THEN I AM WORRIED.
KAREN ANNA LOGJE GAUP, REINDEER HERDER

CLIMATE IMPACT ON REINDEER NOMADISM

Climate analyses show that the area, from Finnmark, Norway in the west to Chukotka in the far east of Russia, mostly is characterized by cold and dry winters with permafrost. From Finnmark in Norway to Sakha (Yakutia) in Eastern Russia the winters become gradually colder and dryer the farther east one goes (Vikhamar-Schuler *et al.* 2010 a). In Sakha the average winter temperatures are usually from -35 to -45°C. Even further east in Chukotka, the winters are milder, but still colder than in Fennoscandia. In Finnmark, the winters tend to be colder in the inland than on the coast, where the open sea adds warmth (Vikhamar-Schuler *et al.* 2010 b). Further east, the contrasts between coast and inland are small, as the Arctic Ocean for the most part is ice covered in winter. In summer the temperature differences between east and west are smaller, but the coastal stations clearly tend to be cooler than the inland stations in all regions. Nearly all stations have their precipitation maximums in summer. Time series of temperature show large inter-annual variability. In Finnmark and Yamal this variation is partly correlated with the North Atlantic Oscillation (NAO)-index (R≈0.5). In Sakha the NAO correlation is highly variable, and in Chukotka it is slightly negative (Vikhamar-Schuler *et al.* 2010 a). Series starting in 1900 or earlier show positive long-term temperature and precipitation trends, though not all these trends are statistically significant. Temperature has increased primarily in spring, while precipitation seems to have increase in all seasons (Vikhamar-Schuler *et al.* 2010 a,b,c). The longest snow season is in general found in the central regions, where the ground typically is snow covered 220–250 days a year. The snow depth, however, is usually smaller in this area than in Finnmark and Chukotka. The largest maximum snow depth on found at the coast of Northern Norway. At the westerly stations, the tendency is that the snow now melts earlier in

Climate scenarios indicate that summer temperatures in Finnmark and the YNAO may increase by 2 to 4°C in 100 years, while winter temperatures may increase by 7 to 8°C (Benestad, 2011). Mainly, the largest temperature increase is projected in the inland, but a large warming is calculated also for the Yamal peninsula. This may be caused by changes in the sea ice conditions. Future scenarios indicate that YNAO winter temperatures in 2070–2100 may be comparable with Finnmark winter temperatures between 1961–1990. Inland temperatures in Finnmark, Norway by then may resemble those of the coastal area of Finnmark (Nordreisa) today. More detailed scenarios for Finnmark (Engen-Skaugen, 2007) show that the annual precipitation may increase by 5 to 30%, the snow season may be 1–3 months shorter, and annual maximum snow depth may increase by 5 to 60%. The largest reductions in snow season and snow depth are projected in coastal areas. A comparison of reindeer herders reports on favorable and unfavorable winters in Finnmark and climate data from the area indicate that temperature and precipitation conditions alone are not critical for the reindeer. However, various combinations of these variables lead to different snow structures which make the pastures more or less available for the reindeer. In order to investigate this closer, a model describing structure and density of

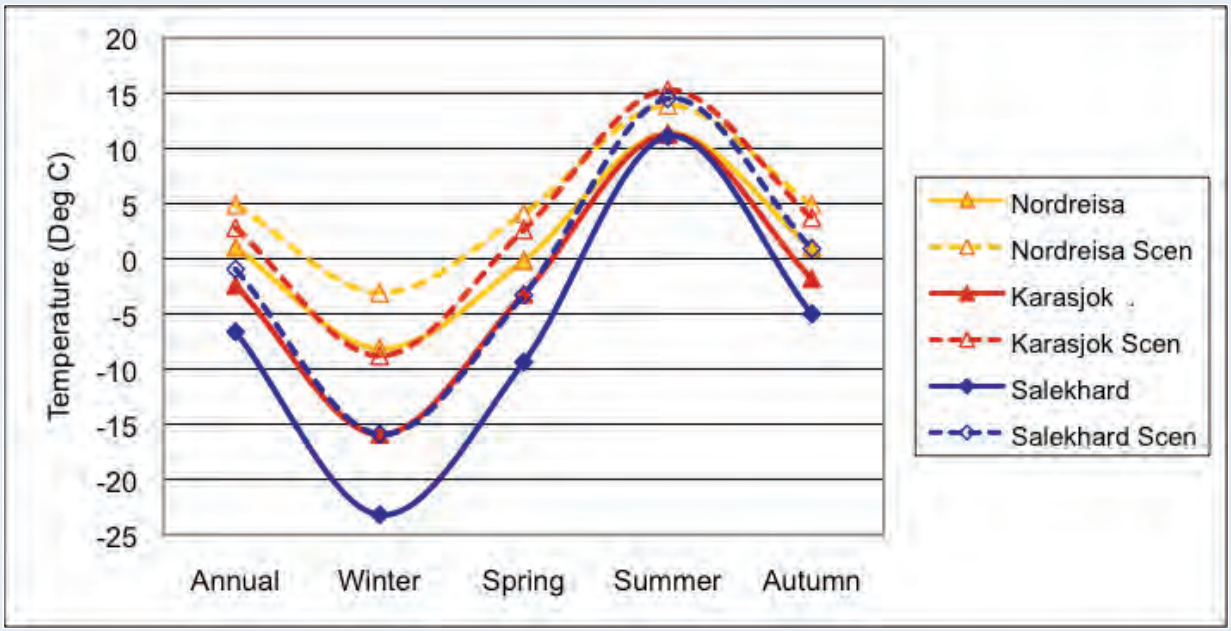
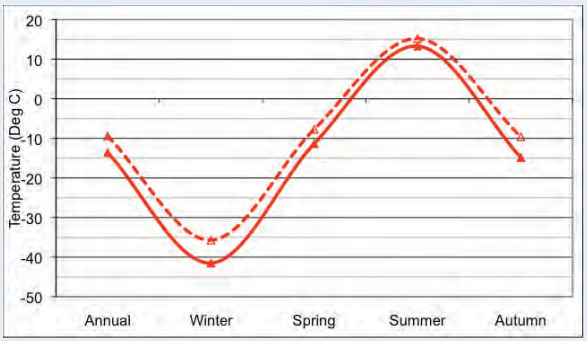


Figure 2A. *Annual and seasonal mean temperatures in coastal Finnmark, Norway (Nordreisa, yellow), inland Finnmark, Norway (Karasjok, red) and Yamal Nenets AO, Russia (Salekhard, blue). Unbroken lines show 1961-1990 observed values. Dotted lines show scenarios for 2071–2100.*

Figure 2B. *Annual and seasonal temperature average for 1961-1990 measured at Tompo (full drawn line) and the similar averages calculated from 50 downscaled climate models for the year 2085 (dotted lines). An EALÁT workshop was also held in the settlement of Topolinoe in the Tompo region in Eastern Sakha (Yakutia), Russia. This is the homeland of Even and Evenki reindeer nomads and one of the coldest regions where reindeer herders live.*



different snow layers was set up (Eira, *in preparation*). The results so far are promising, as there is years that have been reported as problematic by the herders come out with high density snow layers.

REINDEER HERDERS HAVE CONTROLLED VAST AREAS OF THE ARCTIC FOR CENTURIES AND ONLY RECENTLY HAS THE PETROLEUM SECTOR BECOME INTERESTED IN THESE REGIONS. OIL AND GAS HAS APPEARED AND IT WILL DISAPPEAR, BUT THE REINDEER WILL BE THERE FOREVER. TAKE CARE OF OUR REINDEER!

DMITRY O. KHOROLYA, FORMER WRH PRESIDENT

REINDEER PASTURES USE AND LAND USE CHANGE

In this chapter, reindeer pastures and land use change will be described through a closer look at two major reindeer herding regions of Yamal the YNAO. The YNAO in Western Siberia, Russia, with a population exceeding 522,000 is one of the most «urban» regions of the Arctic, compared to only 72800 inhabitants in the county of Finnmark in Norway. The YNAO is characterized by tundra, permafrost and bog vegetation with rivers and lakes, including rich larch forest in the winter pastures, while in Finnmark the pastures include nutrient rich Atlantic coastal vegetation and interior alpine birch forest with lichens.

In the YNAO reindeer herding is based on a strong family-based coupled ecosystem and nomadism. Nomadic herders regularly migrate with transportation reindeer in the traditional Nenets way. The longest migrations constitute up to 1000 km one way from the winter pastures near Nadym south of Ob Bay to the coast of the Kara Sea on the northern part of the Yamal Peninsula in summer. In contrast Sámi reindeer herders in Finnmark may migrate up to 350 km from inland winter pastures to the coastal summer pastures. Reindeer husbandry in Norway is highly dependent on motorized support (snowmobiles and all-terrain vehicles (ATVs) which make it possible to maintain a semi-nomadic lifestyle; while reindeer husbandry in Yamal is completely nomadic and the family follows the reindeer all year round. With a changing climate and increased industrial development, the ability to adapt the fine-tuned survival skills of reindeer herding in an Arctic landscape has become jeopardized as development can terminate, block or delay critical migrations between winter and summer ranges. Infrastructure designed to extract oil, gas, hydropower and minerals may appear insignificant in a seemingly vast undeveloped landscape, but may remove or compete for the few (or even only) migration routes possible across the land, leaving remaining herders highly vulnerable in a changing climate (Degteva and Nellemann, *in preparation*, Maynard *et al.*, 2010; Oskal *et al.*, 2010, Vistnes and Nellemann 2001, 2008, Barlindhaug 2005, Vistnes *et al.* 2009). Both on the Yamal Peninsula and in Finnmark two industrial development projects – gas and copper mining respectively – may block the migration routes of tens of thousands of reindeer with negative impacts on the herders. Such developments can alter the use of pasture areas through avoidance effects of reindeer to such development, infrastructure and human activity (Nellemann *et al.* 2002). The YNAO holds approximately 90% of Russian gas production and 20% of the worlds (www.novatek.ru). In fact, the future welfare of the Russian state and implementation of Russia's Energy Strategy to 2030 is now closely linked with the development of new gas fields in the YNAO region. For example, production from the peninsula's largest field, Bovanenkovo, is expected to begin in 2012. However, the Bovanenkovo area also contains rich and important summer reindeer pastures. The complex plan for industrial development of the peninsula includes the construction of a railway (Obskaya-Bovanenkovo-Kharasavey), renovation of the Kharasavey port, an LNG plant and export terminal associated with the Tambey fields development,

railway and pipelines for oil extraction in the Novy Port area, plus accompanying pipelines, roads, airports and other infrastructure (www.gazprom.com, SibNAC).

Recent EALÁT-NASA studies in Eurasia, which combine remote sensing data with indigenous observations of changes over the past 30 years illustrate the magnitude of large-scale development of oil and gas related infrastructure which has taken place in the area (Degteva and Nellemann, *in preparation*, Kumpula *et al.* 2011, Maynard *et al.* 2010; Oskal *et al.* 2010). A series of cloud-free Landsat scenes between 1972 and 2010 combined with reindeer herder maps and photos provide both space-based and land-based observations of the growth of pipelines, roads, drill pads, buildings and other structures across the grazing areas and migration routes. (Oskal *et al.* 2010). Reindeer herders migrating through Bovanenkovo area are already experiencing negative impacts, but as long as they are able to migrate through the industrial developed areas to the nutrient rich summer pastures on the other sides of the petroleum field, they are willing to accept the development so far. The ability to migrate though these heavily developed pastures might be explained by the close coupling between herders and reindeer, which still is maintained in the YNAO. However, if the development becomes so dense that it is physically impossible to pass through the industrial complex or if migration through the industrial facilities becomes forbidden like for instance in the Hammerfest zone in Norway, it may seriously threaten reindeer pastoralism in the entire Yamal Peninsula (EALÁT workshop report 2009). Significant indirect effects of hydrocarbon development on reindeer herders include herders' lack of access to fish, the introduction of wild dogs, pollution, and an increased number of people visiting the region who have little knowledge about reindeer pastoralism (Forbes *et al.* 2009).

Petroleum development is also influencing and partly threatening Sámi reindeer husbandry in Finnmark. The Oil and gas resources in Finnmark, unlike Yamal, are found only offshore, but generate direct and indirect infrastructure and other development projects on shore in reindeer grazing areas (Vistnes *et al.* 2009). The future of Sámi reindeer husbandry in Finnmark is highly dependent on the availability of grazing land, and loss of pastures is seen as the main challenge for herding in Norway. Extensive offshore oil and gas production, hydro electric dams and power lines, as well as wind power development will lead to loss of vital grazing ranges, in particular coastal summer pastures and calving grounds in Northern Norway. New calculations confirm that continued piecemeal development will substantially reduce grazing grounds in coastal areas, even without additional petroleum development, creating conflicts between herders and new industrial initiatives. However, it has been estimated that, when coupled with extensive petroleum development, an additional 21 000 km^2 of grazing grounds could be degraded in Finnmark. By 2050, up to 78% of the coastal ranges in Northern Norway may be severely disturbed by development, with major impacts on reindeer husbandry

(Vistnes *et al.* 2009). Continued loss of grazing land will constrain reindeer husbandry practices and make the livelihood less capable of handling other future challenges such as climate change. Herd production will likely decrease, while internal and external conflicts will become more common as the competition for resources increase.

Thus, a multi-faceted, long-term adaptation and mitigation strategy must be developed to increase the resilience of reindeer husbandry to these many challenges from land use changes as well as climate change. For example, unless a no-net loss of reindeer grazing ranges is implemented, continued piecemeal development, mainly as a result of activities indirectly associated with petroleum activity, will seriously threaten reindeer herding. Identifying alternative ranges, restoration of current ranges, or the development of mitigation schemes to reduce impacts of current and new activity will be required in order to ensure long-term sustainability and survival of reindeer husbandry.

Furthermore, impact assessment methods must be improved and made to also include reindeer herders' knowledge on traditional land use. This must be combined with estimates of projected future changes in development and climate such as increases in oil and gas infrastructure and associated development, general impacts on the environment, and climate-related changes in order to create long-term predictions of potential adaptation strategies and resilience of local reindeer herding communities in these areas. Reindeer herding communities believe that there is a need to develop Arctic ethical standards, contracts and guidelines which apply to industry regarding the involvement of reindeer herders in the industrial development processes. It is also important to raise awareness and enhance capacity building involving all parties by the development of more impact assessment courses about both industrial and indigenous adaptation processes. It is recommended that transparency and increased involvement in industrial and infrastructure development processes in reindeer herders' communities and other nature-based livelihoods be developed.

An important finding from the EALÁT activities and workshops voiced reindeer herders' lack of information about comprehensive industrial plans on the reindeer pastures. There is an urgent need for these plans to be made available for the public and reindeer herders to understand the future cumulative effects of industrial development and to prepare adaptive strategies to climate change and other changes.

There is also a need to educate both herders and industrial leaders regarding the importance of improved cooperation and communication between the two parties about the ongoing changes in the Arctic. Finally, it is important to establish agreements between indigenous reindeer herders, industry and governments to ensure flexible access to historical pastures and migration routes which can co-exist with increasing development in a changing climate. There is no question that the protection of grazing lands used by reindeer stands out as one of the most important adaptation strategies that can be implemented to ensure long term sustainable reindeer pastoralism as well as to secure flexibility and robustness when facing climate change.

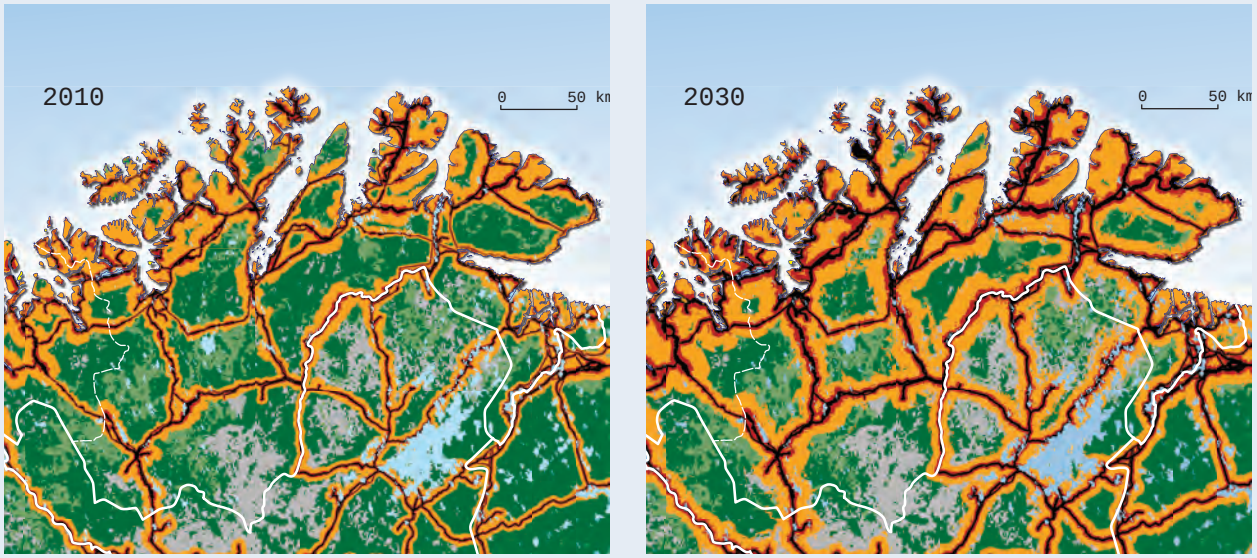
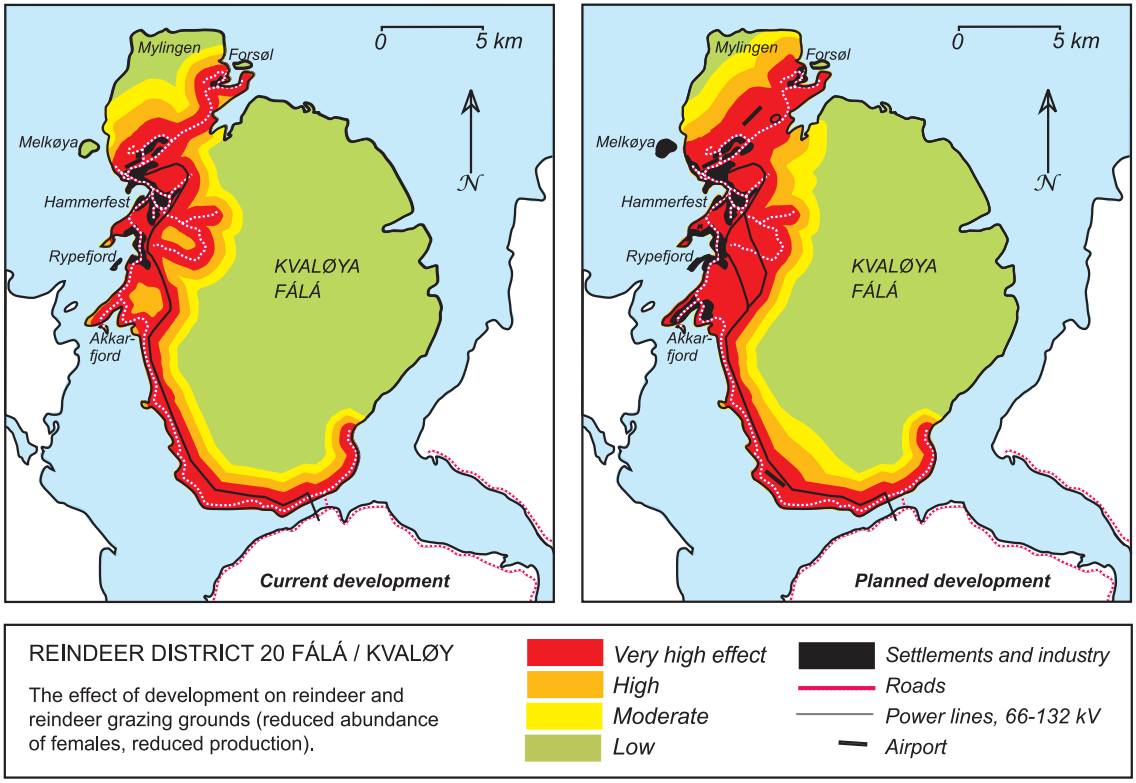


Figure 3. *Development scenarios for the reindeer pastures in Finnmark, Norway using Globio 2 model (www.globio.info.) assuming varying levels of industrial development planed in future. The left map shows to days level of impact of development in the grazing land, while the figure to the right show the impacts with future planned development Black indicate hard impact, red indicate medium – to high impacts and yellow indicate low impacts, finally green indicate reindeer pastures (non impacted areas). The GLOBIO2-model is being developed for and together with UNEP (United Nations Environment Programme) to help assess and map the environmental impact of human development (UNEP 2007). The model has been used by a broad range of regional and global scenarios by several UN-programmes, including UNESCO, UNDP and UNEP. GLOBIO compiles scientific knowledge on global environmental change into a format that is compatible with facilitating policymaking. The model incorporates buffer zones of probability of reduced abundance of wildlife around infrastructure features, such as roads, human settlements, industrial development and more. By using distance zones with varying degree of impacts caused by infrastructure, it is possible to predict the approximate area of impact zones in the future by simple regression analyses using different alternatives of growth, communicating and visualizing environmental changes in such a way that it can be used in sustainable development planning and protection of biodiversity and natural habitats. For detailed methodology, please see appendix 3 and www.globio.info. The scenarios without additional petroleum development (assumption a) are based on the «policy first» scenarios in UNEP (2003).*

Figure 4. *The opening of the Snøhvit (Snow-white) liquid natural gas (LNG) field in the Barents Sea outside Hammerfest in Finnmark, Norway provides a textbook example of how a single industrial project results in a series of associated infrastructure development activities which directly affect reindeer husbandry. In the Snøhvit case, proposed locations of new infrastructure and settlements will hinder access to important reindeer calving grounds on the Mylingen Peninsula. This peninsula also holds historic Sámi sacred sites and offering stones, sites which generally seldom seems to be mapped and taken into consideration in development projects. Alternative locations of new infrastructure could modify negative impacts on reindeer husbandry and keep the corridor to the Mylingen Peninsula open. Landsat satellite image 2009 of Kvaløya, Hammerfest Finnmark Norway (left, courtesy of NASA, 2010 Projected development in Hammerfest (right) (Vistnes et al 2009).*



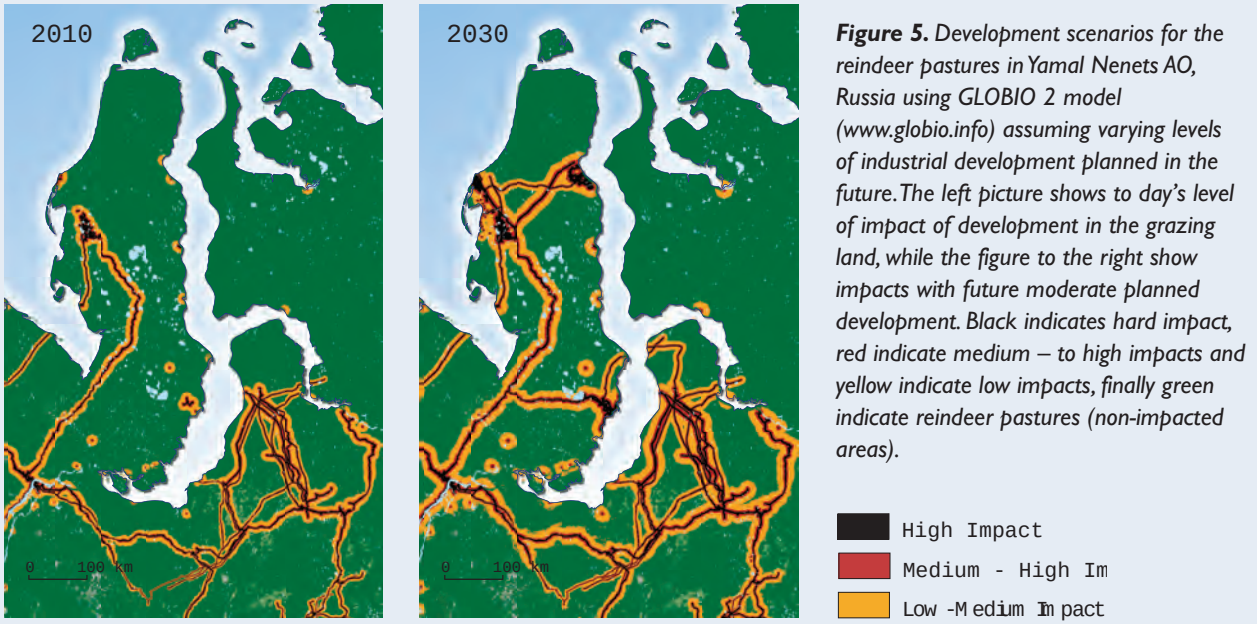


Figure 5. *Development scenarios for the reindeer pastures in Yamal Nenets AO, Russia using GLOBIO 2 model (www.globio.info) assuming varying levels of industrial development planned in the future. The left picture shows to day's level of impact of development in the grazing land, while the figure to the right show impacts with future moderate planned development. Black indicates hard impact, red indicate medium – to high impacts and yellow indicate low impacts, finally green indicate reindeer pastures (non-impacted areas).*

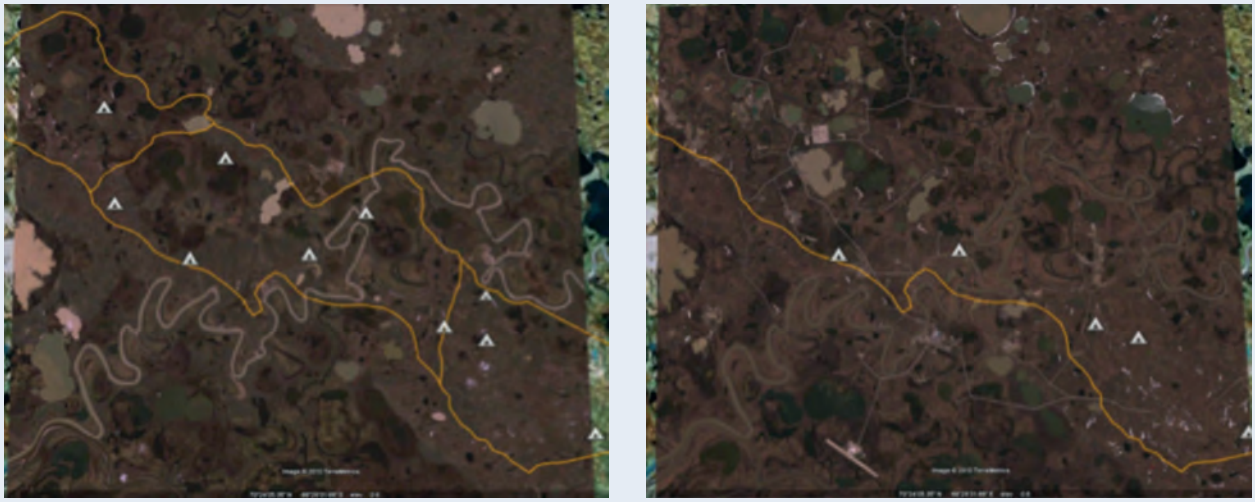


Figure 6. *LANDSAT Satellite mage from 1987 before industrial development started in Bovanenkovo. YNAO (left) and the comparable image from 2009 (right). The routes shown on the left demonstrate the migration route options for herders in 1987, contrasted with the options for migration through this area that remain viable in 2009, as drawn by herders from Brigade 4. White symbols represent traditional camp sites. (Oskal et al. 2010).*

TRADITIONAL KNOWLEDGE IS NOT UTILIZED MUCH. THE PRIMARY REASONS FOR THIS ARE THREEFOLD; ACCESSIBILITY, STATUS AND POWER RELATION. IT HAS NOT BEEN EASY TO OBTAIN THE KNOWLEDGE BECAUSE IT HAS BEEN ACCESSIBLE ONLY TO A LIMITED DEGREE OUTSIDE THE LIVELIHOOD. FURTHER, THE KNOWLEDGE HAS NOT BEEN APPRECIATED BY DIFFERENT ENTITIES.

PROFESSOR OLE HENRIK MAGGA, SAMI UNIVERSITY COLLEGE

REINDEER HERDERS' TRADITIONAL KNOWLEDGE:

CODIFYING HERDERS' ADAPTIVE KNOWLEDGE

Within reindeer herding much knowledge has been generated over time about the reindeer and man's relationship to each other and the relationship between animals and human beings to the natural environment. It is part of what Berkes has defined as traditional ecological knowledge – *a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living things (including humans) with one another and with their environment* (Berkes 2008).

Many studies have demonstrated the correlation between biological knowledge and indigenous and local knowledge. There is also accumulated knowledge of the dramatic changes in the natural environment in the past that has caused years of crisis, and about strategies to adapt to such challenges. This kind of knowledge still forms the main basis for the survival of reindeer herding communities in the Arctic, and has not been replaced or superceded by research-based knowledge. It is available and is in use every day. Nevertheless, such knowledge has been neglected by research and authorities in the circumpolar north. The EALÁT project tried to understand more about strategies within reindeer herding by combining traditional knowledge with modern scientific knowledge. Norway is one of the countries that have committed itself to protect and respect traditional knowledge and our studies can be seen as a beginning to fulfil these obligations.

We have collected and analyzed traditional knowledge of Sámi and Nenets reindeer herding, focusing on winter ecological conditions. Documentation of reindeer herders traditional knowledge related to snow change and adaptation to climate change was carried out in the community based workshops. Furthermore the project has interviewed over 60 elder reindeer herders in western Finnmark about snow and its role in reindeer herding and about historical events, with particular emphasis on «bad years» (called *goavvejahki* in Sámi language). This material includes nearly 1,000 pages of transcribed text in Northern Sámi, which is the professional reindeer herding language in one the areas investigated. A novel method was developed for *Siida* based monitoring of snow change and grazing conditions, based on a herd's diary, where weather, snow conditions and herd behavior were recorded daily by the herder. A Siida is the traditional Sámi reindeer herding unit. Five *siidat* in the west Finnmark reindeer grazing area were included during the period 2007–2009 and show large local variations in snow conditions from early winter to spring. Measurements of temperatures were compared with both reindeer herders' descriptions and meteorological observations in the same area (Eira *et al. in preparation*). The study is a contribution to the understanding of traditional knowledge strategies for dealing with changes in snow conditions under in future climate scenarios. This is a first step to get an insight into the temperature and wind effects on snow conditions locally, through both objective measurements and evaluation

by the herders. by the herders. This represents a novel start that might eventually form a basis for the better prediction of the development of grazing conditions for reindeer. In addition, similar material has been collected from Nenets herders in the YNAO, though less systematically.

According to reindeer herder's traditional knowledge, reindeer behavior patterns can best be understood in the terms of cycles – on the basis of the year, the lunar month and the day-and-night cycle. Nutrient uptake, space for movement, space for rest and shelter are basic elements which in their turn form the prerequisites for growth, physical condition, rutting and calving. The periods within each cycle are related to each other. Some are easily observable such as rutting and calving, while others are more complicated and require experience and deeper studies to be understood. The patterns are influenced by environmental factors, so that flexibility and change are the prerequisites for survival. The cycles are different according to reindeer sex and age. EALÁT is a contribution of documentation, analysis and dissemination of reindeer herders' understanding and knowledge, from a perspective from within herding society. It is important to include this kind of traditional knowledge about reindeer in development of future adaptive strategies for managements of reindeer herding. The methods used are interdisciplinary, with emphasis on linguistics. We recognize that reindeer herders' ability to adapt to change is based on traditional knowledge embodied in their languages, in the institutions of herding and in the action of individual herders. Since snow covered ground and access to pasture plants is a most serious challenge for reindeer forage in terms of climate change, this part of EALÁT focused particularly on knowledge related to snow, reflected in the Sámi terminology of snow conditions and the use the this terminology in herding reindeer The designation of '(good) grazing' *guohtun* (of the verb *guohtut* 'grazing') is used by the majority of reindeer herders with focus on snow conditions. Recently, Roturier and Roue (2009) investigated the concept of *guohtun* related to Swedish forestry and Sámi reindeer husbandry in Sweden. Sámi and Nenets reindeer herders traditional knowledge about snow related to reindeer, reindeer herders and animal welfare represents concrete examples of how traditional knowledge can be used to monitor and adapt to future conditions.

Figure 7. *The gradation from hard snow to less dense snow in Sámi reindeer herding terminology. (from Eira et al. 2010:11-12.)*

According to (Eira *et al.* 2010) Sámi reindeer herders use «basic terms» as *oppas* and *čiegar,* with regard to meaning and characteristics, evaluate the possible survival or grazing condition for the reindeer. The starting-point for the herder's characterization is *oppas*, which describes an area in winter which is unused or untrodden by reindeer (Nielsen 1979 (1932–62) III: 178). If the pasture is not described as *oppas*, then it is *čiegar* to a greater or lesser degree; an area in winter that is trodden/trampled, where reindeer have grazed and changes the snow condition and made the grazing condition poor (Nielsen 1979 (1932–62) I: 382). The terms *oppas – čiegar* are antonyms, which have opposite meanings in reindeer husbandry. They have a mutually exclusive value, and are a dichotomy. When the snow is soft, it is called *luotkko muohta* (Eira 1994: 140), and grazing conditions are good.

The study confirms that the Sámi language is probably the language with the richest terminology on snow, and certainly even richer than the Inuit languages which since the end of the 1800s by linguists have been believed to have most snow words of all languages (Krupnik *et al.* 2002). In North Sámi language alone EALÁT we have documented more than 300 noun stems designating various types of snow and snow conditions (Eira *in preparation*). The central concepts describe snow consistency *(vahca, seaŋáš, čearga, geardni, njáhcu)*, strength of surface layers of snow *(cuoŋu, moarri, luotko muohta)* snow quantity / snow depth *(oppas, muovhllahat, seaggi)* and distribution of snow on the ground *(bearta, bohkolat, časttas)*. Essential is also the influence of the animals themselves on snow where the untouched snow *(oppas)* and grazed snow ground which has become hard *(čiegar)* form the extremes. The last one, *čiegar*, is a common word in both Sámi, the easternmost Fenno-Ungrian languages and Nenets with identical meaning. It is thus an old Arctic word perhaps dating 6000 years back in time (Toivonen, Y. H. 1955).

The Nenets language, which belongs to the Samoyedic language group, is also a professional language for reindeer herding, very rich in words for reindeer, snow and the reindeer herding economy. An initial comparison of its terminology with Sámi shows great similarities between Sámi and Nenets in terms of the structure of concepts, i.e. The same kind of meaning elements are found in the concepts in both languages.

According to Eira *et al.* (2010) reindeer herders use descriptions as the basis for the definition of the snow terms with regard to the factors that govern our understanding of it, and to this they add the physics of snow and thus they are able to see what characteristics the snow term possesses with respect to everyday reindeer-herding, as regards both dimension and use.

Traditional concepts of snow have both similarities and differences with terminology used by snow scientists (Eira *et al. in preparation*). Differences are that the concepts that snow scientists use are based on measurable and quantitative characteristics and less colored by the context. Also, traditional snow concepts often have objective characteristics as a core, but they also contain information and associations to practical matters such as grazing conditions, weather and movement opportunities for the reindeer and the future welfare of the herd.

The fact that the Sámi languages differ significantly from each other is demonstrated by comparison of snow words in North Sámi and South Sámi languages. In the description of the crust and ice sheets, Southern Sámi is more accurate than Northern Sámi. A layer of ice or hard snow may be found both at the top and bottom of the snow pack. Southern Sámi has 17 terms for different kinds of layers in the upper layer of snow. The thinnest layer is cut 'incipient crust of snow (later to become host)' *skaevie*. Medium-hard crust is 'hard snow that carries small reindeer' *tsievie* and hardest is 'ice crust' *njahpedihkie*. Between these, there are 7 words for 7 degrees of hardness. The richness of South Sámi in this respect is remarkable. One reason for this richness is probably that the shifts in the snow has been and is

Photo: Ellen Inga Turi, EALÁT

more frequent in the south than in the inland to the north in Scandinavia. Southern Sámi language also shows independence in this respect in a way that the form of the words themselves are historically different from those of Northern Sámi.

Across the Arctic region there is rich tradition of knowledge about reindeer and reindeer husbandry. The systematic traditional knowledge about reindeer and their environment (Magga 2006) should be further collected and analyzed because it is a source for insight on strategies for survival in the face of climate change, insight into the natural environment, insight into the history of reindeer husbandry and in this may also provide us with knowledge about the people who live there. We firmly believe that all kinds of knowledge should be taken into account, and all kinds of knowledge must also be subject to scrutiny. Elements of traditional knowledge deserve respect if they provide us with better understanding, rather than for any other vague reasons.

THE AREAS OF THE FAR NORTH ARE HISTORICAL AREAS FOR SETTLEMENT OF INDIGENOUS PEOPLES THAT THAT HAVE DEVELOPED AND ADAPTED THEIR CULTURES AND LIVELIHOODS TO THESE MARGINAL ARCTIC AREAS. THERE IS A GREAT DANGER THAT CLIMATE CHANGE IN ARCTIC AND INCREASING ECONOMIC ACTIVITY IN THE NORTH WILL ESPECIALLY IMPACT INDIGENOUS PEOPLES THAT CARRY OUT THEIR NATURE- AND RESOURCE DEPENDENT LIVELIHOODS HERE. THOSE WHO ARE MOST DEPENDENT ON NATURE WILL ALSO BE MOST VULNERABLE.
BERIT OSKAL EIRA, REINDEER HERDER, PREVIOUS VICE MINISTER TO THE NORWEGIAN GOVERNMENT

REINDEER HERDERS SOCIAL AND ECONOMIC ADAPTATION

- INSTITUTIONS AND GOVERNANCE AS CONSTRAINTS AND OPPORTUNITIES

Reindeer herding is based on sequential and flexible usufruct of a wide number of different ecological niches under differing climatic conditions. This flexibility allows herders to adapt to climatic variation and produces resilience: The ability to cope with and adapt to change. An objective of EALÁT has been to determine what and non-climate related factors affect reindeer herders' adaptive capacity and resilience of to changing climatic conditions, factors associated with national and international institutions, governance and customary rights. In this regard there has been a focus on three tasks: i) Determine to which degree national and international law gives support and recognition to protect reindeer herders' traditional knowledge and customary which can be used to strengthened adaptive capacity and resilience of reindeer herders' societies to climate change. ii) Determine how ownership and access to markets can be influenced by climate change. iii) To identify how structures and processes related to multi-level governance influence reindeer herders' adaptive capacity and resilience.

Comparative qualitative case studies with an approach of reindeer pastoralism in Finnmark, and the YNAO were conducted. Analysis has focused on integrating data spanning from the local, regional, national and international scale to gain an understanding of how developments in and interactions between these scales influence reindeer herders' resilience and adaptive capacity. A general review and analysis of relevant legal and governance frameworks in the two case areas has been conducted and combined with interviews with reindeer herders belonging to strategically selected herding groups. Integration with the findings in the subsequent working packages of the EALÁT project, in combination with studies of the social organisation of reindeer pastoralism (Turi, 2008) shows that reindeer herding has developed an integrated resilience for coping with climatic uncertainty based on traditional ecological knowledge. The social organisation through family-based reindeer herding siidas or brigades, i.e. groups of households that keep their animals in a joint herd, and cooperate on tasks associated with reindeer herding, is an important framework for climate change resilience. Governance frameworks at the regional, national and international scales however, have a fundamental impact on reindeer herding and can directly or indirectly influence resilience and adaptive capacity by affecting the livelihoods ability to maintain and develop flexibility, mobility and social-ecological diversity. As a place-based coupled social-ecological system, reindeer pastoralism is primarily a local practice (Sara, 2009), and strategies for building and maintaining resilience based on traditional knowledge are implemented at this level. Such strategies involve building social ecological diversity and flexibility, by preserving institutional flexibility, by preserving herd and pasture diversity as well as preserving diversity in social capital, and applying pastoral mobility as a means for securing social ecological flexibility (Turi, 2008) and diversity. Governance frameworks at the regional, national and international scales however, have a fundamental impact on reindeer herding and can directly or indirectly influence

Photo: Svein D. Mathiesen, EALÁT

resilience and adaptive capacity. An institutional setting where reindeer herders' traditional knowledge and organisation is restricted poses a significant challenge to reindeer herders inherit resilience based on traditional knowledge. Greater focus on the clarification of *siida*-based land rights, and *siida* rights to self-determination in internal affairs is needed (Sara, 2010). Modifying policy incentives that counteract traditional herd diversity and organisation (Reinert, 2006), limit obstacles to access to pastures by re-establishing trans-boundary reindeer herding across Fenno-Scandinavian borders (Reinert *et al.* 2009), and limiting the permanent loss of grazing land, and improving the economic basis for reindeer herding by re-establishing access and ownership to important activities in the value chain such as slaughtering and marketing (Reinert 2006), are identified as crucial strategies whereby governance structures can be applied to increase reindeer herders' adaptive capacity to unprecedented climate change. It is argued that the present loss of the most profitable parts of the reindeer meat value chain (slaughtering and marketing) seriously hampers the herders' ability to cope with change. Coping is costly, and these costs can best be met by giving herders access to the profitable end of the market (Reinert et. al. 2009). Another measure is to re-establish legal autonomy in the social organisation. In order to re-establish the autonomy of the *siida*, traditional *siida* knowledge must be the starting point (Sara, accepted for publication). Further, legal acknowledgement must «imply self-management based on *siida* land rights, customs, traditions, and autonomous processes of knowledge.» (Sara, 2009: 176). Both Norwegian and Russian legislation protects reindeer herders' customary rights and traditional use of grazing areas, which is anchored in international human rights and international indigenous peoples legislations and declarations. Based on the development of indigenous peoples rights internationally, we believe these legislations account both in Finnmark and in the YNAO in Russia when conflicts occur because of competing interests when climate change in the grazing area creates new opportunities and constrains on the sustainability of Sámi and Nenets reindeer husbandry.

Studies in the Nordic context have showed that forestry companies in Sweden were prepared to voluntarily assume larger responsibilities in relation to reindeer herding so as to potentially avoid mandatory requirements developed in relation to international policy in the future (Keskitalo 2008). Studies in the Nordic countries and Russia (Keskitalo *et al.* 2009) have also shown that forest certification, i.e. the development of voluntary market-based labelling systems setting social and ecological production requirements – i.e. regulation beyond the state – has played a large role as an international norm requiring forestry companies to adhere to specific social and ecological demands in their production, among which is included requirements on indigenous rights. Recently, Brandlund and Axelsson (*in press* 2011) have demonstrated that although reindeer management was a much more diverse enterprise earlier than it is now, the major adaptation strategy and constraining forces were similar to those of today. The foremost adaptation strategy was, and still is, the flexible use of pasture area, and the clearest constraints during the 19th century were the loss of authority over the land and the imposed regulation of reindeer management-both of which were strongly connected to the process of colonization.

I HAVE FEW BIG MALES NOW — SO WHO ELSE WILL BREAK THE ICE?
SÁMI REINDEER HERDER, THE LATE MATTIS ASLAKSEN SARA WHEN ANSWERED WHY HE KEPT BARREN FEMALES IN HIS HERD

REINDEER: CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE

What effect will warming and associated climatic phenomena have on reindeer pastoralism? This question has a beguiling simplicity. Concealed behind it is a web of relationships, extant within and between the natural and societal environments, which simultaneously confer resilience on reindeer pastoralism and shape the course of its development. Biological interactions which influence the life history of reindeer - the subject of this section – are, thus, a subset of the greater scheme. Ecological relationships do not define the trajectory that reindeer pastoralism will follow over the next human generation; however, they represent fundamental constraints and opportunities with which herders adapting to a changing world must work.

The aim of this part of EALÁT was to examine annual and individual variation in the body mass of reindeer calves in terms of the simultaneous effects of environmental variation and 'mother effects' which, *sensu* Loison *et al.* (2004), are the combined effects of the genetic and non-genetic qualities of individual mothers on their offspring. We predicted four key results:

1. Variation in the live body mass of calves within annual cohorts greatly exceeds variation between them.

2. Growth of calves is influenced by variation in weather conditions in winter (i.e., during gestation) and in summer (i.e., during the first growing season). Both aspects of environmental variation influence the mean body mass of calves at the end of summer although not necessarily to the same extent.

3. The position of individual calves relative to the annual mean body mass is strongly influenced by various qualities of their mothers.

4. Complex interactions exist between effects of environmental variation and maternal effects, and between different maternal effects. These potentially confer resilience on the system.

There was considerable variation in the body mass of calves both at the end of summer and late in winter. The body mass of males and females in late summer was, on average, 37% and 22%, respectively, greater in heaviest cohort compared with the lightest. The heaviest individual males and females within given cohorts weighed nearly twice as much as the lightest. Many calves lost weight in winter. The cohort mean rates of weight loss varied from 3% to approximately 16% of body mass at the end of summer. Weight loss was probably due largely to partial emptying of the gastrointestinal tract (stomach and intestines) as appetite reduced in winter.

The rank order of cohorts, in terms of body mass, persisted across winter: high or low cohort mean body mass in autumn was usually succeeded by high or low cohort mean body mass at the end of winter in both sexes, respectively.

Thus, cohorts of calves generally did not compensate through winter for poor early growth, and neither did they lose through winter the advantage of a good start in life. Both observations illustrate the importance of the first growing season for the subsequent development of calves.
We analyzed variation in the body mass of calves in terms of the simultaneous effects of 1 'year' or environmental variables (annual variation) and 11 mother effects (individual variation) using linear mixed effects models. Environmental variables included precipitation, population density, snow depth and ambient temperature.

Body mass in late summer was influenced by sex (M>F) and increased with date of capture, age and body mass of the dam, and with ambient temperature in winter and in summer, respectively. Body mass decreased with mothers' age at first reproduction (young first time breeders performed better), with increased snow in the winter of gestation and with increased population density in summer.

Uniquely among 12 variables tested, the effect of age of the dam on body mass was sex specific: no interaction with sex was detected in any of the remaining 11 variables. Body mass increased with age of the dam across three categories: 2, 3 and 4-9 yr., and the effect was more pronounced in male than in female calves. Thus, there was no sex difference in the independent effect of age on body mass in calves reared by 2 yr. old dams (which almost without exception were first time breeders), but male calves reared by dams aged 3 yr. or 4–9 yr. old enjoyed superiority in body mass of 0.9 and 3.6 kg, respectively, compared with females. In contrast, although heavy females wean heavy offspring, absence of sex dependence indicates that this relationship is governed chiefly by the physiological stochiometry of lactation. Differential reproductive effort in favour of males therefore appears to be a function of the age of the dam but not her growth.

Age at first successful reproduction ranged from 2 to 5 yr. Calves of late first time breeders were smaller, at a given body mass of the dam, than those of early first time breeders, resulting in partial reversal of the age effect. Thus, calves born to young females are likely to be heavier than those born to older ones of similar size where the latter are first time breeders. Consistent with lack of cost of reproduction in this species (Weladji *et al.* 2008), body mass of calves was influenced neither by the reproductive status at conception nor the fertility of their mothers.

Calves' body mass at the end of winter at was influenced by 1 their sex (M>F), 11 their body mass at the end of the preceding summer and 111 qualities of their mothers including their body mass and fertility (both positive) and age at first reproduction (negative). Calves' body mass decreased with population density in summer and snow in winter. We detected no independent effect on the body mass of calves at the end of winter of mothers' reproductive status at conception or of ambient temperature in winter. The powerful effect of calves' body mass in summer on their body mass at the end of winter emphasized the overwhelming importance of the first growing season for the subsequent development of reindeer calves.

Snow depth varied threefold across the eight years of the study and was strongly related to variation in climate (the North Atlantic Oscillation (NAO) winter index). The negative effects of snow on body mass were, however, inconclusive in terms of a putative climate driven trend. First, no trend in depth of snow was apparent across the 40 yr. record (1970-2009). Second, the association between snow depth and the NAO broke down in the larger data set. The association between depth of snow and the NAO during the years of the study and, in particular, a strong negative relationship between body mass in late winter and the NAO in raw data (but not in model results) were therefore almost certainly fortuitous.

In contrast with snow, the positive effect of ambient temperature in the winter of gestation on body mass in late summer is potentially highly significant in terms of directional change in the growth of calves owing to a marked rise in

temperature at the winter pasture over the last decade. This trend, although only weakly associated with the NAO in the 40 yr. record, is consistent with projections for the region as a whole. The mechanism underlying the association between winter temperature and body mass remains to be elucidated. The positive effect of summer temperature on body mass, by contrast, is inconclusive in terms of directional change owing to absence of a trend in temperature across the 40 yr. record.

Substantial variation in the body mass of calves at two stages of their early development can be explained in terms of the simultaneous but, contrary to prediction 4 (above), largely independent effects of environmental variation and maternity. The functional relationships between factors in these two classes are highly complex. Recognizing this provides new understanding of the basis of heterogeneity of body size observed in reindeer herds and of the potential influence of climate variation on it. Thus, mean ambient temperature in the winter of gestation was the only one among six abiotic environmental variables tested that could be associated with a putative climate driven trend in growth of calves. Warmer winters projected for the region seem likely to enhance growth of calves in summer. The body mass of calves of both sexes is modulated by powerful maternal effects, some of which enhance and some of which depress growth. These, and similarly powerful effects of environmental fluctuation in five variables besides winter temperature, will probably continue to generate considerable heterogeneity in the growth of calves. The resulting variation in the body mass of calves within and between years will inevitably obscure temperature driven trends in this important variable.

Photo: Philip Burgess, ICR

AVKAS ARE VERY IMPORTANT, SINCE THEY FACILITATE MANAGING OF THE HERD. THEY OBEY PEOPLE AND LEAD THE REST OF THE HERD, RESPOND TO HUMAN CALL AND CAN BE HARNESSED IN CASE OF EMERGENCY.
NYADMA KHUDI, BRIGADIER YNAO, RUSSIA

WELFARE OF REINDEER AND HERDS OF REINDEER – TWO WAYS OF KNOWING

Reindeer are highly adaptable ruminants with specialized digestive mechanisms that enable them to cope with the very large seasonal changes in the nutritional quality and availability of forage characteristic of northern habitats. The winter reindeer pastoralism of the YNAO, is almost entirely based on the sustainable exploitation of natural pastures below the snowpack south of the Ob Bay, likewise the reindeer in Finnmark eat a variety of different plant like lichens, grasses and shrubs.

In both regions investigated, lichens are utilized as a main energy supply by reindeer in winter, but this dietary substrate also contain an antinutrient called usnic acid as a protection against UV-B radiation, herbivores and microorganisms. The predicted increase in exposure to UV-B radiation in the north may increase the content of phenolic secondary compounds in lichens and plants eaten by reindeer reducing their taste and digestibility (Turunen *et al.* 2009). We have, in a classical western scientific way, studied the interactions between usnic acid and the reindeer rumen microflora with one particular goal: to better understand reindeer adaptive capacity and welfare related to UVB and usnic acid. We have revealed a novel bacterium (*Eubacterium rangiferina*) in the reindeer rumen that has adapted mechanisms to deal with the antibiotic usnic acid (Sundset *et al.*, 2008). Usnic acid is degraded by microbes in the reindeer rumen, and consequently not absorbed by the animal itself (Sundset *et al.*, 2010).

This is an example of a new and unique understanding of reindeer welfare and the effect of UVB radiation. It is also an example of adaptive Physiology in Reindeer. Phenolic compounds such as usnic acid have the potential to depress rumen methane production (Patra & Sacena 2010), and hence reduce the loss of energy from the animal and mitigate greenhouse gas emissions. We are consequently searching to identify the effect of usnic acid on the densities of rumen methanogens. Numbers of rumen methanogens are lower in reindeer compared to those found in domestic ruminants (Sundset *et al.* 2009). Low numbers of rumen methanogens found in reindeer suggest that reindeer may emit less methane compared to other ruminants investigated. Greenhouse gas emissions are currently used as an argument to reduce the number of reindeer in Norway. We consequently aim to quantify the emissions of methane and the energy loss this entails for the reindeer at different times of the year and on different diets.

Contrasting from this way of studying reindeer welfare, we also have found that reindeer husbandry as an indigenous production system in extreme, variable and unpredictable climates are based on risk minimization strategies such as crop diversification, and skilled, flexible utilization of existing ecological and climatic niches. In such areas, we argue that long-term climate change will magnify already extreme weather conditions, with unpredictable effects. Adaptive responses to dramatic environmental change are often encoded in traditional knowledge (Reinert *et al.* 2009).

According to Berkes *et al.* (2000), traditional knowledge, as a way of knowing, is similar to Western science in that it is based on an accumulation of observations but it is also different from science in some fundamental ways. The anthropologist Claude Levi-Strauss (1962) argued that these two ways of knowing are two parallel modes of acquiring knowledge about the universe, the two sciences were fundamentally distinct in that the physical worlds is approached from two opposite ends in two cases, one is supremely concrete and the other supremely abstract. In studies of welfare of reindeer and reindeer herds we have included reindeer herder's insights of animal welfare and scientific understanding. The findings document unique knowledge about animal welfare in both Finnmark and the YNAO, and demonstrate the potential bridging between western and indigenous ways of knowing.

Reindeer herders have traditionally maintained high levels of phenotypic diversity in their herds (N. Oskal, 2000; Magga, 2006). The Sámi concept of a 'beautiful' herd of reindeer (Čáppa eallu) incorporates, therefore, a diversity which is the antithesis of the monoculture of homogeneity observed in a pure-bred herd of livestock developed by selection to suit the requirements of modern, high-yielding agricultural ruminant production systems. The traditional diversity of the structure of the reindeer herds reflects a strategy aimed at reducing their vulnerability to the consequences of unfavorable – and unpredictable – conditions. In this way apparently 'non-productive' animals have particular roles, which contribute to the productivity of the herd as a whole. For example, in the 1960's reindeer herds in Finnmark typically comprised as much as 50% adult males, many of which were castrated (Paine, 1994). Surprisingly this is very similar to today's herd structure in the YNAO. They may also have lowered the general level of activity of the females, hence contributing to increased net energy gain in the herd. Modern agronomists have considered adult males unproductive and today few herds in Finnmark comprise more than 10% large bulls, but variation is large (Nilsen, 1998).

The structure of reindeer herds contrasts dramatically from e.g. sheep farming: «Within normal sheep rearing, meat production based on old uncastrated rams is unthinkable. No sheep farmer would use the winter feed – the marginal factor – on a herd of rams that produce less meat than the ewes can produce through the yield of lambs. Today, the line of thinking should be the same in reindeer herding. Male animals that are superfluous from the point of view of procreation occupy grazing grounds that could be employed, instead, for cows. A herd of male animals larger than what is necessary for good insemination results should in that case be based on factors other than meat production, such as tourism or special management techniques» (Lenvik, 1990).

According to Yuzahakov (Yuzhakov and Muhhachev 2001) during the long history of practicing scientific selection, in Russia, not a single breed of reindeer has been created by scientific selection. People (reindeer herders) selection has created five breeds. The concepts of peoples' selection include herds comprised of *avkas* (Sámi: *gesat*) and *khaptarkas* (Sámi: *sainat*), non productive animals which add in modulating the herd behavior. *Avkas* are reindeer in Nenets reindeer herding which from a young age are fed with fish soup, bread or milk regularly by the herder, and can live inside the tents and with herd. Over the last decades in Norway, reindeer managers have reduced the number of castrates for several reasons. One was introduced by the Norwegian Animal Welfare Act. Accordingly, castration of reindeer bulls was only allowed with anaesthesia performed by a veterinarian. In the field, only a bloodless method using the castrating forceps, e.g. the Burdizzo instrument, can be used. The spermatic cord and blood-vessels to the testicles together with the sensitive nerves are crushed and damaged. This is considered painful, and anaesthesia is required. The procedure is costly and time consuming, and in addition to other reasons, the practice has been reduced (Nergård *et al.* 2010).

Vladimir Etylin, from Chuckhi reindeer herding commented on this in 2007:

«Being an indigenous representative and having been born on the tundra myself, I consider [proposed] a ban on castration as a serious threat to all reindeer husbandry. […] Castrated males do have their own place in the herd's structure too. Humans would not have been able to domesticate reindeer without castration. It is one of the cornerstones of the domestication process. […] Without castrations it is not possible to build up a controllable reindeer herd. Geldings have many functions in a reindeer herd. The first one is that they are the calmest animals of a herd. Which means that a reindeer herd with castrates quiets down easily. For example: In Chukotka it is impossible to survive without crushing ice during a so-called black ice period, when everything gets covered with a layer of ice. When this happens only castrates are strong enough to break such ice. […] Reindeer cows follow after them and eat the fodder left over.»

Castrates do not go into rut, are calmer, heavier and we believe, are better snow-diggers in the winter. When winter temperatures rise, thawing and freezing may induce worse ice conditions than earlier, and the access to food for females and calves may be more difficult. We have proposed that the re-introduction of castrates could be a strategy for better winter survival and welfare for individual animals and for the herd. The Sámi castration method *«gaskit»*, was traditionally performed with the teeth, without anaesthesia. Animals castrated with *«gaskit»* methods sometimes behave differently from those castrated with the Burdizzo (Nergård *et al.* 2010). In our present study we have compared different castration methods, describe the mechanism behind the *«gaskit»* method and to ask how they affect the animal and the herd. Furthermore, combining traditional knowledge and new technologies we have preliminarily demonstrated the effective castration after immunization of reindeer bulls with an anti-GnRH vaccine. We hope that the reintroduction of an old method to support herders adapt to climate change by bridging new technologies with traditional knowledge, will increase the number of castrates in the herd thereby building resilience to climate change in Sámi reindeer herding.

As a consequence of the changes, in Sámi reindeer husbandry during the last 30 years, described, the increased supplementary feeding in winter in Finnmark Norway has subsequently increased. The provision of small amounts of supplementary feed can improve survival in winter and increase the degree of tameness of the herd. The pattern of increased feeding might alter if the incidence of unfavorable snow conditions increase. Restricted access to pasture during winter due to crusted snow or ice may expose animals to starvation that depresses rumen fermentation resulting in weight loss or even death. A probiotic may alleviate these problems and hence increase animal welfare. The reindeer rumen represents a unique and complex symbiotic microbial ecosystem evolved through a long history of feeding on Arctic plants and lichens (Mackie *et al.*, 2003; Sundset *et al.*, 2007). We have thus searched for putative probiotics among anaerobic rumen bacterial isolates from reindeer to increase welfare related to winter feeding. Climate change is likely to affect the Sámi region in Norway and the YNAO in Russia with greater variability in temperature, precipitation and wind, and higher winter temperatures. Resilience thinking draws therefore attention to the importance of recognizing all present knowledge both scientific and traditional knowledge including restructuring of herds to decrease vulnerability to or increased supplementary feeding of reindeer.

Photo: Svein D. Mathiesen, EALÁT

Figure 8. *Reindeer herders build resilience in reindeer husbandry by spreading the risk through investing in biological diversity such as maintaining different kind of phenotypic reindeer like castrated animals in the herd.*

WE LIKE EALÁT BECAUSE IT IS ABOUT LIFE.
CLAUDIA TIKHONOVA, EVENKI REINDEER HERDER, SAKHA (YAKUTIA), RUSSIA

EALÁT COMMUNITY BASED WORKSHOPS IN THE CIRCUMPOLAR NORTH

Local community based workshops organized within the reindeer herding societies in tundra and taiga reindeer herding regions focus on information on climate change how traditional knowledge is used and how traditional grazing land is lost. One part of the IPY EALÁT consortium was EALÁT-Information, which aimed to be the voice of reindeer herders to the Arctic Council on climate change issues, promoting local competence building for indigenous peoples. The challenge of EALÁT-Information is to take reindeer herders' knowledge into action for sustainable development of the Arctic and, in particular, involve Russian and Scandinavian reindeer herders in this process, and give some concrete examples how herders' traditional knowledge relates to adaptation to changing conditions, including traditional use of grazing lands.

The community based workshops have provided an arena where scientific and traditional knowledge could meet, be measured up against each other, facilitating dialogue and sharing of understanding between reindeer herding communities and scientific communities. The concept has also included local authorities, bringing governance in as a third dimension. In this process, the participants of the different communities have gained increased insights into the others knowledge base, understandings and perspectives. The workshops have thus provided a format where it has been natural to seek to integrate the «different ways of knowing» (I. M. G. Eira) with each other.

With EALÁT a collaborative process between science, herding communities and authorities throughout the circumpolar north has been initiated, processes which provide knowledge and answers that neither group could have come up with on their own. As EALÁT sees the challenges of global changes in the north to be of such proportions that we need to use the best available knowledge to adapt, these processes – although arguably at very early stages – could prove crucial in the search for local answers to future adaptation challenges. In this regard, the process of EALÁT and the community based workshops is seen as very valuable on its own, and perhaps even the most important contribution given that we do not yet see the full scale and impacts of the changes that are coming. Seen in relation to long term perspectives, it seems obvious that the timeframe of the actual project can only provide us with a 'snapshot' of the development ahead. Still, developing understanding for current changes and adaptation strategies is important for building a foundation of knowledge and for processing experiences for future adaptation measures and leadership. In terms of pastures, local climate and topographic conditions, there is a high diversity in the investigated reindeer herding regions, indicating that the original adaptive capacity of reindeer herding as a system may be high.

The adaptation challenges facing reindeer husbandry also seems to differ greatly geographically, clearly demonstrated by the community based workshops in different regions. As a starting point, EALÁT sees adaptation to climate change

Photo: Svein D. Mathiesen, EALÁT

Figure 9. *EALÁT Community based workshop August 3rd 2009 Yamal Peninsula, Yamal Nenets AO Western Siberia, Russia with Nenets, Komi and Sámi herders and youth.*

as something happening at the local level, where the actual impacts are felt. EALÁT thus represents a place based approach, where local reindeer herding societies are themselves involved in defining risks and possible adaptation strategies, in a process of co-production of knowledge. A key aspect of the EALÁT concept is local capacity building. This is understood as building knowledge and knowledge institutions locally, in order to increase the local indigenous communities own adaptive capacity to coming changes. As a pilot initiative for local capacity building following the

EALÁT workshops and activities in the circumpolar regions, there has now been established three local reindeer herding centres in the Republic of Sakha (Yakutia) in Eastern Siberia: The Centre for Taiga Reindeer Husbandry in Khatystyr, Aldansky region, the Centre for Tundra Reindeer Husbandry in Uryung-Khaya, Anabarsky region, the Centre for Forest-Tundra Reindeer Husbandry in Olenek, Oleneksky region. There is also the initiative to establish a College for Reindeer Husbandry, Teachers and Eveny Cultural Centre in Topolinoe, in the Tomponsky region of Sakha Republic. These institutions have been established as a collaboration between the International Centre for Reindeer Husbandry, local authorities and the Republic of Sakha (Yakutia), linked to EALÁT and IPY. They are funded primarily by local authorities, and are working to maintain and develop a sustainable reindeer husbandry in the face of change. This is a very concrete outcome of EALÁT locally.

Following EALÁT a housing program for reindeer herders has also been implemented in Sakha, building new houses for seasonal use by reindeer herding families in some of the least hospitable natural environments in the world. In the wake of this program, the citizens of Khatystyr municipality was voted to call the new street with such houses «EALÁT Street». Although this was a non-intended side-effect of an ongoing process, it goes to show that the place-based working model of EALÁT can have impacts on local societies, influencing people and their lives in different ways. All workshops voiced the importance of private ownership to individual reindeer to strengthen resilience in their society and motivate people to have an active and meaningful life.

EALÁT INFORMATION HAS THUS FAR ORGANIZED THE FOLLOWING COMMUNITY-BASED WORKSHOPS:

1. Kautokeino, Norway, February 2007 (Startup)
2. Nadym, Yamal-Nenets AO, Russia, March 2007
3. Anadyr, Chukotka AO, Russia, February 2008
4. Kanchalan, Chukotka AO, Russia, February-March 2008
5. Yar-Sale, Yamal-Nenets AO, Russia, September 2008
6. Topolinoe, Sakha Rep., Russia, April 2008
7. Khatystyr, Sakha Rep., Russia, September 2008
8. Bol'shoy Nimnyr, Sakha Rep., Russia, September 2008
9. Inari, Finland, September 2008
10. Khatystyr, Sakha Rep., Russia, February 2009
11. Khralovo, Yamal-Nenets AO, Russia, August 2009
12. Uryung-Khaya, Sakha Rep., Russia, March 2010
13. Saskylakh, Sakha Rep., Russia, March 2010
14. Khatystyr, Sakha Rep., Russia, March 2010
15. Lengra, Sakha Rep., Russia, March 2010
16. Naryan-Mar, Nenets AO, Russia, September 2010
17. Khorey-Ver tundra, Nenets AO, Russia, September 2010
18. Ammarnäs, Sweden, October 2010
19. Mittådalen, Sweden, October 2010
20. Inuvik, Canada March 2011
21. Olenek, Sakha Yakutia, April 2011

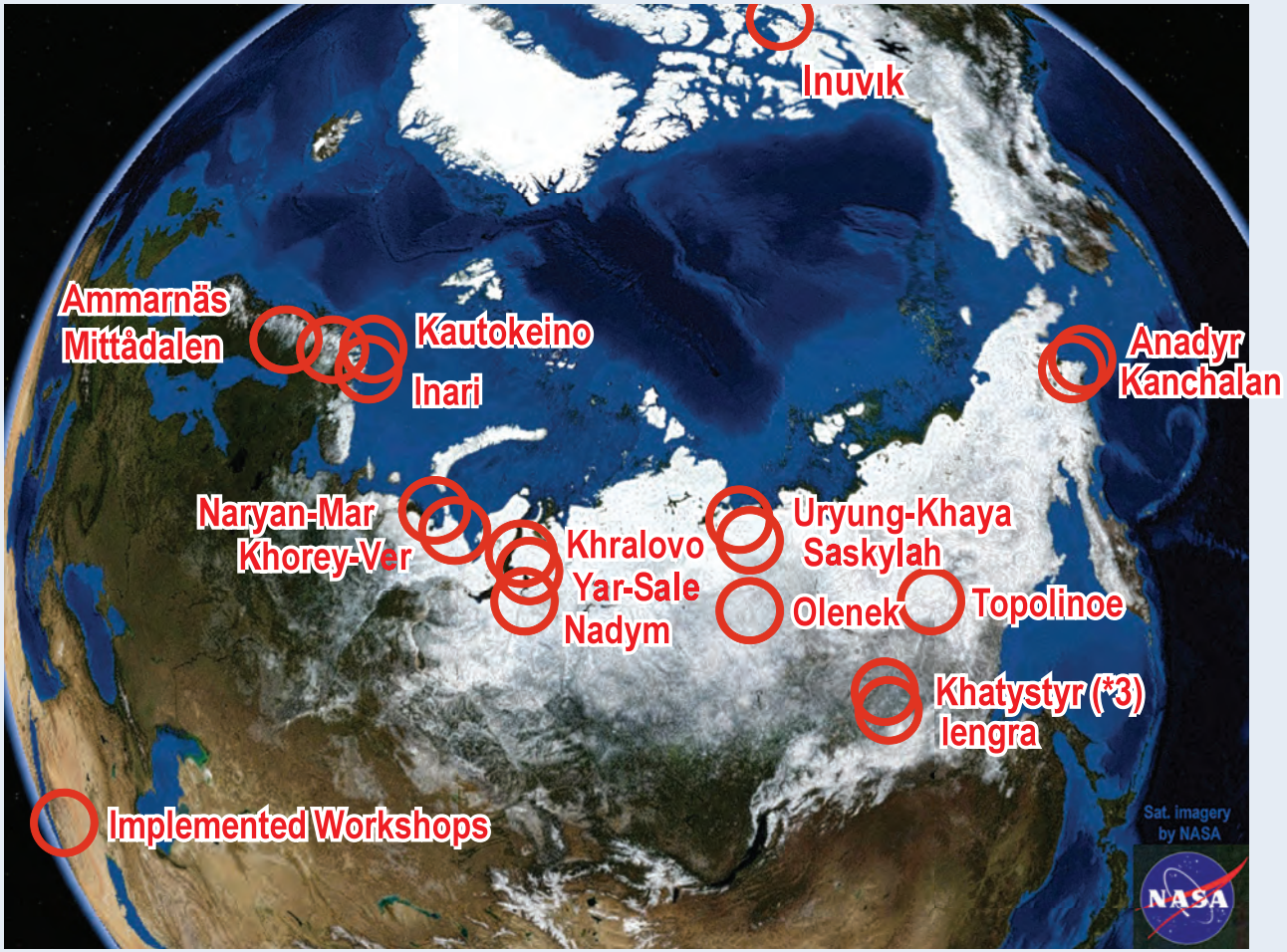


Figure 10. *NASA satellite image of Eurasia with snow covering the ground showing all 21 local reindeer herders' communities where Arctic Council SDWG EALÁT community based workshops have been held.*

THE CASE OF REINDEER HUSBANDRY IN SAKHA (YAKUTIA), RUSSIA.

EALÁT workshops (8) were hold within reindeer herding communities in the Republic of Sakha (Yakutia) in eastern Russia. The Republic is the largest region of the Russian Federation with territory covering some 1/5 of the Russian Federation. With such a vast size, reindeer herding here is as diverse as the region itself. The Republic of Sakha (Yakutia) includes high Arctic, sub-arctic, mountain-taiga and taiga. Five distinct indigenous peoples herd reindeer in Sakha: Eveny, Evenki, Dolgan, Yukagirs and Chukchi. Some 25% of the entire Republic is considered as reindeer pastures though it has been estimated that there are more lands in the Republic which potentially could be used as grazing lands for reindeer (National Report, 2009), signifying its potential for growth. The vast majority of reindeer pastures and potential pastures are in the forestry zone of the Republic (State National Report, 2009). This is important as according to Russian legislation, the forestry lands are under Federal management, while lands designated agricultural are under the management of local authorities.

Currently there are over 200 000 reindeer are herded by over 2200 people who work and migrate with reindeer full time. Reindeer are primarily owned by various state, public or collective organization bodies, although nearly 10% are held privately (Ministry of Agriculture of the Republic of Sakha (Yakutia), 2010). There are a wide variety of subsidies that are provided to herders by the regions in areas that include increasing livestock, transportation, and education.

Participants of the EALÁT workshops throughout the Republic repeatedly stated that the full extent of the loss of reindeer pastures, due to construction and infrastructural development such as power lines, roads etc. had not been

Figure 11. *Reindeer husbandry zones and sites of established network of information centers for reindeer husbandry in Sakha (Yakutia).*

evaluated and that this had given rise to great uncertainty with regard to the quality and extent of pastures. The Republic is rich in resources and key to the region's future plans are the implementation of numerous large scale development projects, several of which are already under way. Herders called for a system of monitoring to be implemented that gave a fuller picture of pasture loss.

For example, in the Anabar district which is representative of tundra reindeer husbandry, pastures are being lost due to the activities of diamond mining, as well as localized coal mining activities. Reindeer herders have had to move from their pastures in this district due to such activities (EALÁT workshop in Uryung-Khaya 2010). Wild reindeer have increasingly become a concern for herders in the North of the Republic and this was reiterated by participants of the EALÁT workshops both in Anabar and Olenek. Herders called for the development of monitoring systems of migrations of wild reindeer and to include traditional knowledge into the monitoring process and the analysis of the results.

An EALÁT workshop was also held in the settlement of Topolinoe in the Tompo region. Here, large scale mining activities (gold, copper, coal and more) are planned. However, the potential impact of these plans on reindeer herders and reindeer pastures has not yet been investigated. Traditional land use activities has so far been ignored nor has there been any discussion of the concept of compensation for these losses.

The participants of the workshops held in Southern Yakutia – in Khatystyr, Bolshoy Nimnyr and Iengra were particularly concerned about industrial development in their territories', in particular with the reduction of reindeer pastures, environmental degradation and the lack of dialogue between herders and industrial companies. Herders reported that their interests were not being taken into consideration when decisions regarding the development of the area were being made. For example, the reindeer herding community «Idzhek» has repeatedly appealed to RusHydro company with the demand to take the herders' interests into account when designing and constructing the Cancun hydro power plant. The winter pastures of the community are in the area of the proposed hydroelectric dam and will be flooded. However, no formal response was received neither from the company nor from representatives of the government (Results from the EALÁT workshop in Khatystyr, 2009)

Photo: Anders Oskal, ICR

Photo: Anders Oskal, ICR

TAIGA REINDEER HUSBANDRY

Taiga reindeer husbandry is one of the most unique and ancient types of reindeer husbandry practiced today in Russia, China and Mongolia. Taiga reindeer husbandry differs from other types of reindeer husbandry in that herds are smaller and herders ride and milk their reindeer.

Traditionally, these communities combine herding with the hunting of wild animals and game in the taiga (Klokov, 2004). Evenki herders use reindeer as transport when they hunt for wild reindeer, sable, bear, muss etc. In taiga and forest regions, the livelihood and culture of the reindeer herders is increasingly threatened by hunting restrictions and wildlife conservation, development activities (such as minerals and forestry), and increased exposure to livestock diseases. All the while, communities face a growing need for cash in order to access education and healthcare (Klokov, 2004). For indigenous pastoral peoples the loss of reindeer also means the loss of livelihood, culture and identity, with the ultimate risk of an indigenous people disappearing altogether. During the last few decades Kets, Nganasans as well as several communities of Evenki, Eveny, Chukchi and other indigenous peoples have lost their tradition of reindeer husbandry which has resulted in the acceleration of their assimilation. Reindeer herders of forest and taiga zones are particularly exposed to this risk. Therefore, a legacy of IPY EALÁT is to focus on the challenges of taiga reindeer husbandry and their societies in cooperation with Russia, Mongolia and the UN.

USE OF TRADITIONAL KNOWLEDGE

Despite the historical and socio-economic upheavals of the last century, the reindeer peoples, regions and cultures of Sakha (Yakutia) remain deeply embedded within a system that is underpinned by traditional knowledge and an indigenous understanding of the environment as a highly complex system. From generation to generation the herders of Sakha (Yakutia) have passed on their knowledge about herding practices, landscape, climate and weather, vegetation, biology and behavior of animals. By way of example this system of knowledge allows reindeer herders to protect their herds from insects and heat and find solutions for better grazing when extreme weather events occur. Reindeer herders burn a special kind of moss and reindeer droppings to make a smoke in order to protect reindeer against insects. They also build shelters (*khaltama*) to prevent the herd from suffering from the heat during the hottest periods of summer. Herders also use ice-deposits (permafrost) to cool the herd and diminish insect harassment. These are some of the strategies that may be impacted should climate variability increase, as is predicted. Herders have always adapted to climatic changes in the region, varying their migration routes for example, or varying their pasture management strategies according to local climate variability's. This is pasture management based on the traditional know--ledge of landscape, vegetation and climate. Therefore, the ability to retain mobility and the continued availability of certain lands and the herders knowledge how and when to use them is crucial to the welfare of the whole herd and by extension, the herding community. Due to increased industrial development in reindeer pastures this has created challenges for herders, such as disturbance of animals, loss and/ or degradation of pastures, loss of biodiversity and increased poaching of reindeer. When combined, these elements serve to limit herders coping and adaptation strategies. Taiga reindeer husbandry is an ancient presence in Sakha (Yakutia) and embodies an body of knowledge of how to adapt to changes, including climate change in the region and to lose this knowledge would represent a broad loss to humanity.

As a result of EALÁT workshops in Khatystyr and Aldan and as a potential contribution to development of communication and dialogue between reindeer herders and industrial developers an Information Centre for Taiga Reindeer Husbandry was established in Khatystyr supported by the government of the Aldan region and Khatystyr municipality. During the EALÁT work in Sakha Republic similar centres were established in Uryung-Khaya, Anabar district (Tundra reindeer husbandry), Olenek, Oleneksky district (Forest-Tundra reindeer husbandry) and there is an initiative to establish a college for reindeer husbandry in Topolinoe, Tomponsky district. Recently, in another positive development – the JSC «Corporation ofIntegrated Development of Southern Yakutia» has applied to the Association of Indigenous Peoples of Sakha Republic to sign an agreement of cooperation to avoid conflicts, develop social partnership and support indigenous activities in the region. The rapid changes in the taiga region in Sahka (Yakutia) is a threat to reindeer husbandry and the herders societies. The voice of reindeer herders should be included in further development of the region.

THE CASE OF REINDEER HUSBANDRY IN SWEDEN: HÄRJEDALEN

«This, of course, is the real problem.. Not having a place to be in the winter. We have a group that has no land to be on at all.»

– Martin Eriksson reindeer Herder in Handölsdalen

In Sweden, the Sámi reindeer herding area stretches from the Finnish border in the north to Dalarna County in the south of the country. The area covers 226 000 sq km, which is 55% of Sweden's landmass. The reindeer herding area is divided into 51 reindeer herding districts, or so called Sami Villages. There were 4668 reindeer owners in Sweden in 2008/2009, more than 900 were responsible for a herding group or a company. The responsible owner is usually a person who actually works with reindeer or is owner of a reindeer herding enterprise. The total number of reindeer in Sweden varies between 225 000 and 280 000 and in 2009/2010 there were just over 250 000 animals.

One of the Arctic Council EALÁT-information place-based workshops in Sweden was held in Mittådalen, a small village in the southernmost reindeer husbandry area in Sweden and Sápmi within the County of Jämtland, in cooperation with the project *Eallinbiras* of the Sami Parliament in Sweden and the Saami Council. The five Sámi villages of Härjedalen (Handölsdalen, Tåssåsen, Mittådalen, Ruvhten Sijte and Idre) have their summer pastures in the western areas towards the border of Norway and their winter pastures in the Swedish inland forests. These villages are often known as the *Sami villages of Härjedalen.*

In Härjedalen the so-called *Härjedalen case* (Härjedalsmålet) was initiated in 1990 when private land owners sued the five Sami villages of Härjedalen, claiming that the villages have no right to graze their reindeer on land to which the land-owners hold formal title, but which the reindeer herders maintain constitutes traditional reindeer grazing lands. In 1996, the Court of First instance concluded that the Sami villages hold no customary rights to the land areas in dispute and the Court of Appeals (2002) confirmed the first instance's ruling, and finally in 2004 the Supreme Court denied further appeal. Sámi villages fared so poorly in these court proceedings can to a large extent be explained by Swedish rules of evidence at that time being influenced by Swedish cultural practice. Swedish law seemed to place the burden of proof on the Sami villages, who had to prove that each specific area has traditionally been used for reindeer pasture. Further-more, the evidence presented was evaluated by a standard rooted in Swedish culture, which rendered it difficult for Sami villages to prove that they had traditionally used a particular estate for pasture. The courts focused on written documents and remnants in the terrain. The Sámi culture is oral by nature, where knowledge is passed on orally from generation to generation, and traditionally it is the aspiration of the reindeer herder to leave no trace in nature, when one leaves a place. These factors combined implied that it was difficult for the Sámi villages to prove their traditional presence in the area.

The Swedish conventional legal system has been designed to deal with land conflicts were both parties' claims are rooted in traditional Swedish land use, and not with conflicts where one party pursue the semi-nomadic reindeer husbandry particular to the Sámi culture. As a consequence, when such a legal system deals with conflicts between the Swedish and Sámi society, there is a risk that the Sámi villages are disadvantaged. There seems to be essentially two possible solutions: Either the state amends the legislation to create a more level playing field. Alternatively, the courts take a

progressive approach, and cater for justice by acknowledging the particularities of the Sami culture in their reasoning. At the time of the *Härjedalen Case*, none of these paths had been pursued.

Swedish authorities have not yet found a political solution to the problem with Swedish title-holders bringing Sámi villages to courts. The Sami villages in Härjedalen have, since the trial started, asked for support from the Swedish government to find a political solution to the conflict. For instance, they have suggested a compensation fund so that it should not be necessary to bring the case to court. Furthermore, the Sámi villages together with the landowners made a proposal where they asked for economical support to find an agreement with out a solution made (Borchert 2001: 52). Having won the law suit, the title holders have demanded that the Sámi villages pay a tenancy fee for using the areas in dispute. The Sámi villages' primary position has been that the law-suit was unjust, and the Swedish state must take responsibility it. They have therefore maintained that the Swedish government should expropriate their grazing rights from the title-holders. According to the reindeer herders, Sweden has up until now not been able to discuss these opportunities for solutions to this difficult issue. Instead, the government has supported the title-holders in insisting on that the only solution for continued reindeer husbandry in the area is a negotiated agreement on a tenancy fee between the Sámi villages and the title-holders. Sámi villages and reindeer herders report that the government has suggested to reduce their numbers of reindeer if they refuse to sign an agreement. Negotiations on an agreement has thus gone on for years, but have not resulted in an agreement since the title-holders have demanded a fee the villages consider they cannot afford to pay. Although the Sámi villages are principally strongly against paying for the land they consider as theirs, and will find difficulties in paying also a relatively lower tenancy fee, they might feel forced to sign the agreement.

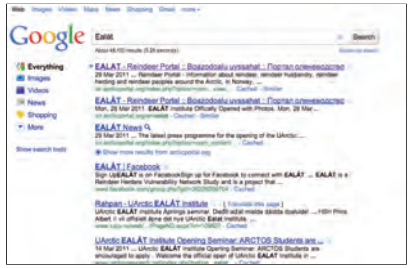
Recently, on 27 April 2011, the Swedish Supreme Court delivered its ruling in another reindeer grazing case, the so-called Nordmaling Case. The Supreme Court found in favor of the Sámi villages sued in that case. In doing so, the Supreme Court changed its earlier practice, indicating a change in Swedish law and jurisprudence. The Supreme Court took account of the particularities of reindeer herding, that it is an oral, nomadic life-style that leaves few traces on the ground. It allowed the grazing-pattern of the reindeer to exercise considerable influence over the geographical extent of the grazing right. In short, the Supreme Court exercised an unbiased model for trying whether the Sámi villages had established rights to their traditional territories.

The Härjedalen Case is an example that loss of grazing land can also be due to governance. The Sámi village of Handölsdalen for instance has lost half of their winter pastures in the Härjedalen case, and now has to rely on transport of reindeer by trailers instead of their traditional nomadic migration over spring and autumn pastures. What is more, law-suits are not the only kind of loss of grazing land that reindeer husbandry face in this area. Piecemeal development is a serious issue, here as in other reindeer herding areas, and a particular strong stakeholder in the southernmost reindeer husbandry area is the tourism industry. During the EALÁT workshop two skiing resorts, located between the Sámi villages of *Mittådalen* and *Ruvhten Sijte*, were visited. During the last 10–15 years the tourism has developed greatly with tourism activities still expanding, taking lands from the Sámi villages in demand. The *Destination Funäsdalen*

Photo: Helena Omma, ICR

tourism development project, partly funded by the European Union, was what concerned the reindeer herders of the EALÁT workshop in Härjedalen the most, besides the *Härjedalen Case*. What is more, one has to remember, that reindeer husbandry in Härjedalen is not spared from other kinds of industrial development, quite the opposite – they are highly affected by e.g. forestry, infrastructure and coming wind-power development. Climate change adaptation is thus currently not considered the most imminent issue in the region, but will likely further add to the other challenges of land use change. The EALÁT project has so far not been able to identify traditional knowledge-based adaptation measures that would efficiently handle the consequences of the observed pasture loss in Härjedalen, indicating that these kind of losses might make the reindeer herders vulnerable to future climate change in this region.

OUTREACH OF EALÁT KNOWLEDGE: THE REINDEER PORTAL



No1 for Google Search 'EALÁT'.

EALÁT home page, hosted on the Arctic Portal

100 000 visitors, 250,000 pages, 161 countries

Developing online tools to facilitate outreach and information was a key component of the outreach and information portion of the IPY EALÁT project. The Reindeer Portal (www.reindeer-portal.org), the EALÁT website (www.ealat.org) and the Reindeer Blog (www.reindeerblog.org) have evolved into stable and effective means of implementing electronic outreach to further the aims and goals of the EALÁT project and by extension the International Centre for Reindeer Husbandry and by extension again, outreach information about the background and challenges that face reindeer husbandry to a global audience in general. The EALÁT site carries information about the project, the research goals, publications, new on activities, and extensive video and photography archive, a document archive, live feed data on climate and several other innovative features and is now ranked Number 1 for Google search «EALAT».

The combined traffic to all integrated websites is now over 100 000 visitors who have visited over 250,000 pages arriving from 161 countries (Norway, USA, Canada, Iceland, UK, Sweden, Russia, Finland, Germany and Denmark making the top ten visiting countries). This outreach portion of the EALÁT project has been intensely collaborative – both in terms of international technical partners (the Arctic Portal, utilizing open source software, Polarview, the Meteorological Institute, NASA and others), but also in terms of partnerships at the community level: web partnerships emphasizing communication between reindeer peoples which have been established with several communities in the YNAO, the Republic of Sakha (Yakutia) neighboring Finland. These partnerships were established during the IPY EALÁT project but are designed to outlast the project and continue as an IPY legacy. Multiple training sessions have been carried out with this in mind. Translation of primary texts into Sámi and Russian, with English being the primary language has also been prioritized and the implementation of new tools to enhance diverse and local engagement with the Portal (self submission of video, multiple authorship, sms based tools, and the initial development of smart phone tools) will continue to ensure that this portion of the EALÁT project remains relevant to end users.

EALÁT IS AN INSTRUMENT FOR BUILDING ADAPTIVE CAPACITY AND KNOWLEDGE IN THE CIRCUMPOLAR NORTH

JOHAN MATHIS TURI REINDEER HERDER

TEACHING, LEARNING AND BUILDING COMPETENCE LOCALLY IN REINDEER HERDERS' SOCIETIES

EALÁT has contributed to the building of local competence by expanding and enhancing local understanding of the challenges facing local communities who depend on traditional livelihoods as a result of climate change and other factors related to globalization, such as loss pastures, a key concern for reindeer herding societies. This has provided reindeer herders' societies', organizations and relevant local, regional and governing agencies with new insights and knowledge through a variety of methods. These include but are not limited to a series of new university and college courses related to sustainable reindeer husbandry, climate change issues and the importance taking into account both scientific and local, or traditional knowledge.

A specific objective has been to enhance competency in reindeer pastoralist societies in Norway and Russia. The EALÁT project has demonstrated that the coupled human-ecological systems in the North, in this case, based upon reindeer pastoralism, are sensitive to climate change, due to the high variability of Arctic climate and the characteristics intrinsic to traditional livelihoods such as those practiced by reindeer herders. By enhancing the recruitment of young scientists from local communities, and supporting institution building for indigenous organizations, the EALÁT project has supported capacity building for indigenous societies.

We conclude that adaptation to climate change demands the training of local Arctic leaders in long term sustainable thinking, based on the best available adaptation strategies and knowledge, which draws upon both scientific and experienced-based traditional knowledge. We recommend that national adaptation strategies must recognize the specific challenges facing indigenous peoples within their borders and recognize the importance and validity of the knowledge embedded within these communities. We also recommend that national policies should take steps to actively support indigenous peoples' traditional knowledge, and their cultural and linguistic diversity and support and invest in future education programmes that support these goals.

Bachelor course: «Learning by herding»

At the Sámi University College in Kautokeino, Norway, the EALÁT project has developed a unique course in reindeer husbandry with a focus on human-coupled ecosystems, titled «Learning by Herding» which has enrolled more than 55 students from reindeer herders communities over the last 4 years. Leading scientists from both the natural and social sciences have participated together with Sámi reindeer herders possessing an in-depth understanding and practice in traditional knowledge as teachers, supervisors and examiners. The students have been trained to include knowledge from science and traditional knowledge in their writing, discussions and oral presentations in topics related to reindeer herding. One such topic was traditional knowledge as representing a common knowledge resource of indigenous reindeer herders and how important it is to include such knowledge in the management of natural

resources locally. By way of example the course included sessions that featured elder reindeer herders discussing snow characteristics in the field alongside cryospheric scientists using their tools of the trade to explain the same phenomena.

Such sessions were not limited to Kautokeino. A series of lectures was also carried for young Nenets reindeer herding students on the bachelor level at the Salekhard Agricultural Technical College in the YNAO. It is important to remember that learning about adaptation to climate change takes roots where knowledge about climate variability and change is developed and used.

Online education for Sámi Reindeer Herders (SAJO)

Experience shows that the school system in Norway is poorly adapted to reindeer herding, and it has limited the possibilities for reindeer herders to take part in educational programs. Students own knowledge is not acknowledged or integrated, and the means by which programs are organized in space and time is not adapted to the cyclical rhythms of reindeer herding. This program is about developing and implementing a flexible and integrated education model for young reindeer herders, whom until now have not had sufficient opportunity to participate in ordinary education programs at colleges and universities. The aim of this model is twofold:

- Reindeer herders' traditional knowledge is used as a basis for developing the model
- Herders knowledge is combined with conventional school-based knowledge.

Students can continue working as reindeer herders as they simultaneously take part in educational programs adapted to reindeer husbandry. The link between traditional knowledge and science contributes to knowledge of relevance to the practice of reindeer herding conduct, and the theories of professional practice. That fact that research is conducted in a context involving both researchers and practitioners, will bring new knowledge to both fields of practice and research. As a result, the collective understanding of reindeer husbandry will be enhanced.

In the future, climate change will be a challenge for reindeer husbandry. Therefore the monitoring and experience of these changes by reindeer herders will be important with regard to adapting to climate change. Data and information technology (ICT) is a key tool in verbal activation, systematization and dissemination of reindeer herding knowledge, and has the potential to build bridges between different knowledge traditions. Experience so far shows that it is possible to implement a vocational based education model adapted to the needs of reindeer herders in a way that enables traditional knowledge and science to go hand in hand. Currently, there are 41 reindeer herders who have joined the online course and program (SAJO). IPY EALÁT Phd student Mathis Bongo has developed this programme and was awarded a prize for being the best online teacher in Norway in 2010.

Higher degree students

Both Master's and Phd students and post doctoral fellows have contributed to work within the EALÁT project, in fields of meteorology, linguistics, geography, ecology, veterinary medicine, biology, political science and anthropology. Multiple institutions have been in cooperation including the University of Oslo and Tromsø the Norwegian School of Veterinary Science, University of Umeå, St Petersburg State University and Sámi University College.

Adaptation to globalization of the Arctic (AGA) a following up of ACIA and an online adaptation course from EALÁT in cooperation with UARCTIC

Another unique delivery for IPY EALÁT is AGA: Adaptation to Globalization in the Arctic: The Case of Reindeer Husbandry. This is an online course on the Masters level in the Thematic Networks programme of the University of the Arctic and is a following up of ACIA Chapter 17. The entire course is delivered online and went live in January 2011 with over 30 students participating, either for credit (8 ECTS/ 4 Credits) or for audit. Enrolled students are from Russia, Norway, Finland, Sweden, the USA and Canada. Development of this course was initiated in 2006 and has been co-ordinated by International Centre for Reindeer Husbandry. The final product is a collaboration between the International Centre for Reindeer Husbandry, the Sámi University College, the Norwegian School of Veterinary Sciences, the Arctic Portal Iceland, the Thule Institute, and the University of Oulu, Finland. Participating lecturers were from USA, Canada, Finland Russia and Norway and include scientists and reindeer herders signalling a unique cooperation in the circumpolar north.

More than 30 students registered for this Master of Science course from all over the circumpolar north including Russia, Finland, Sweden, Norway, USA and Canada. The course allows the IPY EALÁT project to voice that societal transformations associated with globalisation are leading to the loss of understanding of nomadic reindeer herding practices. This course is a unique outcome and product of an IPY project as it disseminates information about reindeer husbandry to a circumpolar network of students and interested parties, leading to a broader engagement by main-stream society for whom this is a marginal livelihood practiced in a remote part of the globe.

Teacher training

IPY EALÁT has organized two courses for more than 25 high school teachers from throughout Norway. One course was in sustainable reindeer husbandry, traditional knowledge and climate change and was held in Kautokeino, Norway in the winter of 2008. A subsequent course was held the following year on sea Sámi culture, history and subsistence in the village of Tana, Norway.

Photo: Philip Burgess, ICR

IPY EALÁT LEGACY

The IPY EALÁT consortium has established a unique institutional data and knowledge sharing network in the circumpolar North. It will be maintained for the future co-operation between peoples and states beyond the IPY era. In implementing these efforts, the Association of World Reindeer Herders, the International Centre for Reindeer Husbandry, and the Sámi University College have established a UArctic EALÁT Institute University of the Arctic Institute for Circumpolar Reindeer Husbandry (UArctic EALÁT Institute) as a legacy of the International Polar Year 2007–2008. The Institute shall be a tool for recruiting indigenous youth to scientific work, by continuing the work of IPY EALÁT by focusing on building competence locally in indigenous peoples societies.

THE FOUNDING PRINCIPLES OF UARCTIC EALÁT INSTITUTE ARE TO:

- Increase the educational and research capacity of Arctic peoples, especially indigenous and reindeer herding peoples.
- Increase public understanding for Arctic issues and challenges for indigenous peoples and reindeer husbandry, including the monitoring of land use change.
- Replicating to other regions affected by climate change and globalization the lessons learned and knowledge of indigenous peoples and their abilities and strategies to deal with such changes.
- The institute shall have a circumpolar focus, and work for the benefit of Arctic residents with a specific focus on indigenous and reindeer herding peoples.
- The Institute is a legacy of the International Polar Year, where all partners in the IPY EALÁT Network Study and other partners are invited to participate on equal terms

VULNERABILITY, RESILIENCE, ADAPTIVE CAPACITY IN REINDEER HERDERS' SOCIETY

Reindeer have major cultural and economic significance for Arctic indigenous peoples and circumpolar reindeer husbandry has a long history in the North; reindeer herders have managed vast areas in the Arctic over millennia (Federova, 2003). There are few 'pure' ecosystems without human influence in the North, and human beings are an integral part of nearly all ecosystems. An interdisciplinary and multicultural approach to the factors that influence how climate change affects land-based ecosystems in northern regions is therefore important. Reindeer people's response to changes in the environment have developed operating practices that are now hampered because of several non-climatic factors such as the degradation and/or loss of grazing land, and inability in some jurisdictions toown reindeer privately. Terrestrial ecosystems in the north are very complex. Changes in these ecosystems are now taking place rapidly due to climatic changes and the effects of the industrial development in the Arctic. It is therefore important that we use all available knowledge, both scientific and indigenous peoples' traditional ecosystem knowledge in of ecosystems order to understand the changes and develop new management models. This will require a new type of co-operation between industry, research, management and politics. It is important to use herders' traditional knowledge to understand the ecological contexts. Indigenous and local community participation in research is the key to improving the management of nature in the North and to avoid conflicts related nature use. According to O'Brien *et al.* 2009 «The Norwegian social contract currently focuses on autonomy and rights, fails to recognize the factors and knowledge that underlie the livelihoods of Sámi reindeer herders, such as the importance of maintaining diversity in reindeer herds. The state-assumed responsibility for regulating reindeer production undermines the resilience of reindeer pastoralists by insisting on the use of equilibrium-based management tools such as carrying capacity». We therefore want to contribute to 'a new social contract' between science and society through the development of knowledge partnerships where reindeer herders' traditional knowledge is included. A self sustaining reindeer husbandry based on reindeer herders own values is important as an adaptive strategy to future climate change.

IPY EALÁT has provided new opportunities for young reindeer herders to meet other young herders in workshops, lectures, research projects and cultural exchange. Today, views regarding traditional knowledge have evolved. The global community has again begun to demand the implementation of local and traditional knowledge, and even institutions such as the United Nations require and encourage that traditional knowledge be embedded into the management of the natural environment. This change in attitudes has a clear connection to the challenges that our world is facing. Both leaders and citizens have begun to realize that we need more comprehensive perspectives regarding the management of our natural environment. This is a field where traditional knowledge and scientific knowledge have the potential to complement each other.

The project also revealed that the restructuring and flexible adjustment of reindeer herds may decrease vulnerability to future climate change. It indicated the need to modify government incentives and to improve understanding of biodiversity and traditional knowledge. The EALÁT project is concerned with the major increase in human activities linked to climate change and with the resulting loss of grazing land for reindeer. Grazing land has to be protected as an adaptive measure to cope with climate change and to support sustainable Arctic societies.

We therefore conclude that IPY EALÁT has not only been important for indigenous peoples societies' but also has been important for the scientific communities and has brought forth new insights and understanding based on different world views knowledge and values. It is important that all available knowledge has to be included when developing adaptation strategies to climate change and other challenges in the Arctic.

Photo: Svein D. Mathiesen, EALÁT

Photo: Mikhail Pogodaev, EALÁT

Photo: Philip Burgess, EALÁT

RECOMMENDATIONS FROM EALÁT

1) ***Reaffirm*** that reindeer as a species, their grazing land and reindeer herding culture have a special significance for human life and economy in the Arctic.

2) ***Be aware*** that with climate change reindeer herders' ability to adapt becomes jeopardized as industrial development destroy, block or delay critical migrations between seasonal pastures.

3) ***Support*** transparency in industrial and infrastructure development processes in the Arctic towards local indigenous communities and nature-based livelihoods.

4) ***Support*** that grazing land used for reindeer and caribou has to be protected as an adaptive measure to climate change, biodiversity and sustainable Arctic societies.

5) ***Determine*** the status of reindeer pastures within each of the Arctic states and facilitate the process of surveying and registration of reindeer pastures within national states.

6) ***Support*** establishment of community-based monitoring of climate change in circumpolar reindeer herding areas, linked to SAON, where local languages and reindeer herders traditional knowledge is included.

7) ***Improve*** the impact assessments related to loss of grazing land by including reindeer herders and indigenous peoples' traditional knowledge and their understanding of the ecology and the environment.

8) ***Emphasize*** the need for capacity building for reindeer herding youth in local indigenous communities in face of climate change and land use change in the Arctic, including courses in impact assessments and reindeer herders food cultures and security.

9) ***Support*** Arctic indigenous peoples' right to governance of their own knowledge as an adaptive measure to climate change and degradation of grazing land

10) ***Acknowledge*** the established reindeer herding centers in the Sakha (Yakutia) Republic of the Russian Federation as an IPY EALÁT Legacy, (Information Centres for Taiga Reindeer Husbandry (Khatystyr, Aldan district), for Tundra Reindeer Husbandry (Uryung-Khaya, Anabar district), for Forest-Tundra Reindeer Husbandry (Olenek, Olenek district) and Reindeer Husbandry College in Topolinoe, Tompo district) as well as ongoing processes to establish similar centers elsewhere in Russia and Fennoscandia.

11) ***Support*** improvement of the family-based economy of indigenous reindeer herders in face of climate change and land use change, by securing their access to markets for their own products.

12) ***Support*** that circumpolar reindeer husbandry should gain the status of a world cultural heritage under UNESCO.

13) ***Support*** further development of the work of IPY EALÁT, with a focus on reindeer herding youth in Norway, Sweden, Finland, Russia, Alaska/ US, Canada and Greenland, and encourage further collaboration with indigenous caribou and reindeer hunting peoples.

14) ***Support*** the continuing participation and contributions from circumpolar reindeer herding peoples their communities, organizations and institutions in the IPY LEGACY (International Polar Decade) IPD. Furthermore, strengthening the cooperation of the circumpolar reindeer herders' network, including the IPY legacy, the University of the Arctic Institute for Circumpolar Reindeer Husbandry, (UArctic EALÁT Institute)

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Photo: Svein D. Mathiesen, EALÁT

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