Proceedings
12th Arctic Ungulate Conference (AUC)
Yakutsk, Republic of Sakha (Yakutia), Russia
8 – 13 August 2007

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norden

Nordic Council of Ministers

Nordic Council for Reindeer Husbandry Research (NOR) was founded in 1980 to promoting cooperation in research on reindeer and reindeer husbandry. From 1993 the organisation is under the auspices of the Nordic Council of Ministers (the Ministers of Agriculture). The work of NOR depends on funds from the member governments (Finland, Norway and Sweden).

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Special Issue No. 18

RANGIFER

Proceedings of the Twelfth Arctic Ungulate Conference
Yakutsk, Republic of Sakha (Yakutia)
The Russian Federation
8–13 August 2007

Special Issue No. 18

RANGIFER

Proceedings of the 12th Arctic Ungulate Conference

Editors:
Arnoldus S. Blix & Rolf E. Haugerud

Published by Nordic Council for Reindeer Husbandry Research (NOR)
Tromsø, Norway 2009

About the conference' logo

The logo for the 12th AUC is created by Anatoly and Nikolay Alexeev based on a 3500 to 4000 year old Scythian rock carving of a reindeer from the Sukhanikha area of the upper Yenisei which was copied from N.L. Chlenov (1962). *Scythian Reindeer. Proc. and Invest. Archeology.* Moscow, USSR.

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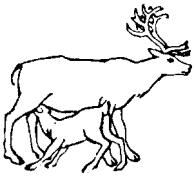

RANGIFER

Special Issue 2009 No. 18

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Preface

The series of Arctic Ungulate Conferences (AUC) was started by an initiative by Jack Luick, David Klein and Robert White, who organized the First International Reindeer/Caribou Symposium, held at Fairbanks, Alaska, in 1972. Then 7 years went by until the Second International Reindeer/Caribou Symposium was held at Røros, Norway, in 1979. Thereafter International Reindeer/Caribou Symposia were organized on a tri-annual basis: the Third at Saariselkä, Finland, in 1982, the Fourth at Whitehorse, Canada, in 1985, the Fifth at Arvidsjaur, Sweden, in 1988 and the Sixth was due to be held at Nuuk, Greenland, in 1991.

However, in 1984, a First International Muskox Symposium was held at Fairbanks, Alaska, later to be followed by the Second International Muskox Symposium at Saskatoon, Canada, in 1987. At the time of the Nuuk symposium in 1991 it was realized that there was not enough material to go around for both tri-annual reindeer/caribou and muskox symposia, since both meetings were pretty much catering for the same group of people. It was therefore decided that a conference dealing with all arctic ungulates should be held every four years, and the Nuuk meeting therefore became the First International Arctic Ungulate Conference in 1991. The Second International Arctic Ungulate Conference was held in due time at Fairbanks, Alaska, in 1995, but at the time for the third conference it had become clear that the terminology, based on three different series of conferences, was confusing and it was therefore decided that the next meeting would become the 10th International Arctic Ungulate Conference at Tromsø, Norway, in 1999. Thereafter the 11th International Arctic Ungulate Conference was held at Saariselkä, Finland, in 2003 and the 12th at Yakutsk, Russia, in 2007.

The year 2007 was a significant moment for Russia and Yakutia with reference to such events as the celebration of the 375th Anniversary of Yakutian unification with the Russia, the foundation of Yakutsk, and the International Polar Year (2007-2009).

The present conference at Yakutsk was organized as part of the meeting of the International Forum on Study and Conservation of the Arctic Wildlife with the Department of National Affairs and Federal Relations of the Sakha Republic (Yakutia) of Russian Federation as principal organizer. Within this framework, the following meetings took place in Yakutsk 8-13 August 2007:

- The 12th Arctic Ungulate Conference (AUC)
- The 3rd International Conferences on Migrating Birds of Asian Pacific Region (ICM)
- Round Table on International Aspects of Protection and Usage of Wild Life of Arctic Region.

The present proceedings are based in part on the abstract collection that had been published in Russian before the conference by V.M. Safranov (ed.) and includes abstracts of the papers that were presented at the 12th Arctic Ungulate Conference.

The production of the proceedings is a result of cooperation between the organizers in Yakutsk (Russia), the Arctic Ungulate Society (AUS) and the Nordic Council for Reindeer Husbandry Research (NOR), with financial support from the Norwegian Reindeer Husbandry Development Fund. We thank Maria Nakhshina for translation services.

The editors

Photograph of participants

The participants at the International Forum on Study and Conservation of the Arctic Wildlife, including the 12th Arctic Ungulate Conference, outside the Russian drama theatre, named after A. S. Pushkin, where the opening ceremony took place. Photo: The Organizers.

Panel of dignitaries at the opening ceremony of International Forum on Study and Conservation of the Arctic Wildlife. From left: Arnoldus S. Blix, President of the International Arctic Ungulate Society (AUS); Ayal Stepanov, Deputy Chairman of Government of the Republic of Sakha; Claire Mirande, Director of the International Foundation of Cranes; Minacshi Nagendran, Representative of US Fish and Game Service; Rolf E. Haugerud, Secretary General of the Nordic Council for Reindeer Husbandry Research (NOR); Anatolyi F. Kovshar, Academy of Sciences of Republic of Kazakhstan; Anatoly Alexeev, Coordinator of the 12th Arctic Ungulate Conference (AUC). Additional to a series of welcoming addresses from some of the above and numerous others the opening ceremony offered an impressive display of traditional Yakutian dances and other cultural displays. Photo: B. Inga.

Organizers

Organizing Institutions

Department of National Affairs and Federal Relations of the Sakha Republic (Yakutia) of Russian Federation;
Institute of Cryolite Zone Biological Problems of Siberian branch of the Russian Academy of Sciences;
Yakutsk Research and Development Institute of Agriculture;
Siberian branch of the Russian Academy of Sciences and Yakutsk State University.

Organizing Committee of the International Forum on Study and Conservation of the Arctic Wildlife

A. Stepanov – deputy chairman of government of Republic of Sakha (Yakutia), chairman of organizing committee;
A. Migalkin – chief of department of national affairs and federative relations of Republic of Sakha (Yakutia), deputy chairman of organizing committee;
V. Grigoriev – minister of nature conservation of Republic of Sakha (Yakutia);
R. Dmitriev – minister of agriculture of Republic of Sakha (Yakutia);
A. Alekseev – rector of Yakutsk State University;
F. Pestryakov – chief of department of Press and TV and radio broadcasting of Republic of Sakha (Yakutia);
M. Borisova – deputy minister of finance of Republic of Sakha (Yakutia);
V. Kondratiev – deputy minister of economic development of Republic of Sakha (Yakutia);
N. Solomonov – professor, counselor of Russian academy of sciences, corresponding member of RAS;
A. Alekseev – assistant professor, Yakutsk State University, member Executive Committee of International Arctic Ungulate Society;
N. Germogenov – deputy director of Institute for Biological Problems of Cryolithozone of Siberian branch of Russian Academy of Sciences, director of Yakutian coordination group of the project UNEP/ GEF «Sterkh»;
M. Neustroev – professor and director of Yakutsk Scientific Research Institute of Agriculture.

Conference Technical Committee

V. Safronov, chairman;
I. Okhlopkov
V. Stepanova

Scientific Committee of the 12th Arctic Ungulate Conference

Anatoly Alekseev – assistant professor of archeology and Yakutian history, Yakutsk State University, coordinator of the 12th AUC, Yakutsk;
Michael Neustroev – professor, deputy director of Yakutsk Research and Development Institute of Agriculture, Siberian branch of the Russian Academy of Agricultural Sciences, Yakutsk;
Valery Safronov – dr, Institute of Cryolite Zone Biological Problems of Siberian Branch of Russian Academy of Sciences, Yakutsk;
Nikolai Karpov – dr, Institute of Cryolite Zone Biological Problems of Siberian Branch of Russian Academy of Sciences, Yakutsk;
Chuner Taksami – dr, St. Petersburg;
Leonid Kolpashikov – dr, chief of biological resources department of Research and Development Institute of Extreme North Agriculture of the Siberian Branch of the Russian Academy of Agricultural Sciences, Norilsk;
Konstantin Klokov – dr, chief of laboratory of geography society and regional policies of Research and Development Institute of Geography, St. Petersburg State University;
Innokenty Okhlopkov – chief of laboratory of mountain and subarctic systems, Institute of Cryolite Zone Biological Problems of Siberian Branch of Russian Academy of Sciences, Yakutsk;
Andrey Popov – deputy director of Department of Biological Resources of Sakha (Yakutia) Republic, Yakutsk;
Piers Vitebsky – dr, Scott Polar Research Institute, Cambridge, UK;
Mauri Nieminen – dr, senior research scientist, Finnish Game and Fisheries Research Institute, Reindeer Research Station, Kaamanen, Finland.

Conference Programme

8th August

Opening Ceremony

Opening ceremony and cultural performance at Russian drama theatre after the name of A. S. Pushkin.

Opening Address

Ayal STEPANOV, Deputy Chairman of Government of Republic of Sakha (Yakutia), Chairman of Organizing Committee of the International Forum on Study and Conservation of the Arctic Wildlife.

Welcoming Addresses

Vyacheslav SHTYROV, President of Republic of Sakha (Yakutia) (read).
Yevgenia MIKHAILOVA, Vice-President of Republic of Sakha (Yakutia) (read).
Afanasy MIGALKIN, Chief of Department of National Affairs and Federative Relations of Republic of Sakha (Yakutia), Deputy Chairman of the International Forum on Study and Conservation of the Arctic Wildlife.
Vladimir GRIGORIEV, Minister of nature conservation of Republic of Sakha (Yakutia).

Addresses by official representatives

Claire MIRANDE (USA), Director of International Foundation of Cranes.
Arnoldus BLIX (Norway), Professor and President of the International Arctic Ungulate Society.
M. GULYUKIN (Russia), Director of All-Russian Institute of Experimental Veterinary Science, Professor, and Academician of RASKhN.
Nikolay DROZDOV (Russia), Professor of Moscow State University.
Nikita SOLOMONOV (Russia), Professor, corresponding member of RAS and counselor of Russian Academy of Sciences.

Closing of the opening ceremony

A folklore performance and photographing of participants closed the opening ceremony.

12th AUC

Venue: Conference hall, Yakutsk State University after the name of M. K. Ammosov.

Opening session

Chairmen: Leonid Baskin (Russia), Leonid Kolpashikov (Russia), Valery Safronov (Russia), Boris Soloviev (Russia), and Mauri Nieminen (Finland).

V. G. Tikhonov, A. L. Popov, S. S. Egorov, Iu. S. Lukovtsev, & F. G. Iakovlev.
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V. V. Mikhailov & V. Iu. Mordovin.
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B. Åhman, A. Skarin, S. Raukola, & Ö. Danell.
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V. M. Etylin & V. N. Nuvano.
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G. Osipova.
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On the morphology of *Cervus elaphus* L. (1758) of Yakutia. (Page 46).

M. K. Sleptsov.
Metabolic plasticity in the Yakutian horse. (Page 48).

A. I. Anufriev, V. M. Safronov, T. G. Samsonova, & N. G. Solomonov.
Body temperature change in reindeer during an annual cycle. (Page 49).

V. F. Iadrikhinskii, N. G. Solomonov, & A. I. Anufriev.
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J. Kumpula, A. Colpaert, A. Tanskanen, M. Anttonen, H. Törmänen, & J. Siitari.
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Importance of selenium microelement for agricultural animals. (Page 61).

10th-12th August

Conference Excursions

Group I
By bus and ferry across Lena river to south-eastern Amga region situated some 200 km from Yakutsk. Sightseeing of aboriginal Yakut horse herds and a horse breeding station, visit to village offering impressive folklore program and to the holy mountain at Amga river, in which some enjoyed a swim. Overnight stay at a rural farm.

Group II
By bus and ferry across Lena river to Buotama river about 120 km from Yakutsk. Visit to forest bison nursery and animals brought to Yakutsk in April 2006 from Canada and sightseeing of the landscape of Central Yakutia and Lena river.

12th August Afternoon

Conference Dinner

13th August

Closing Ceremony

Closing ceremony of the International Forum on Study and Conservation of the Arctic Wildlife at the Academy of Sciences of Sakha Republic.

Opening address[1]
By the Deputy Chairman of Government of Republic of Sakha (Yakutia),

A. I. Stepanov

Major areas of cooperation in the sphere of environmental protection of the Arctic

Dear colleagues and guests!

Humanity has entered the new millennium with a heavy burden of problems and unsolvable contradictions. Experts from the Roman Club described this state of things as "limits of growth". Further development of civilization is limited by a range of factors that have a strong destabilizing impact on all spheres of human activity. Our civilization's crisis is obvious and the most important component of this crisis is an ecological one.

Ecological crisis means that human interference into environment has reached a stage when change, particularly in biosphere, is irreversible. Humanity draws all necessary biological and non-biological resources from the environment and returns waste that is difficult to process or impossible to process naturally. This practice has lead to collapse of some unique ecosystems in the Arctic and North, and some of them are under threat of extinction.

Arctic regions of Russia make up about one third of northern polar areas of the planet and play an exclusively important role in the climatic system of the planet, remaining a wild, untouched biospheric reserve that performs ecological functions on a global scale. Arctic regions provide more than 11% of Russian national income with the share of population constituting only 1%. Today, the export share of the Arctic is about 22% from the All-Russian one. The Arctic brings more than 60% of currency to Russian economy due to selling of oil, gas, coal, gold, diamonds, nickel and other minerals, as well as fish and timber.

Dynamic anthropogenic change of ecosystems has lead to the formation of new cenosis that are in confrontation with already existing species, including human beings. At the same time, succession is a regular natural phenomenon. However, when occurring naturally, it involves mechanisms of cenosis change that have developed throughout evolution process. Any erroneous interruption of this process is destructive for a species that does not conform to the law of nature. Catastrophic consequences of global climate change at the end of Cretaceous period were the main cause of cenosis change when highly specialized species died out giving way to more ecologically flexible ones. This marked the end of dinosaurs' era and start of the era of warm-blooded animals which were better adapted to the changed environment.

Humanity will suffer the same fate if no measures are taken to preserve the environment. Mankind today consumes about 40% of photosynthesis' production, almost one third of world fresh water reserves and unreasonably uses nonrenewable resources that are running out fast. By the year 2020, energy consumption will increase by 75%, which in turn implies increase of emission of greenhouse gases into atmosphere. Amount of accumulated waste will reach an unprecedented level in the first quarter of the 21st century and increase several times compared to the current level. Content of carbon dioxide has reached a critical level by the year 1989 and increases every year. According to scientific prognoses, average temperature of earth surface can increase by 1.3 degrees Celsius. The most pessimistic scenarios predict global warming already in the first half of the 21st century. Models show that climate in Moscow's latitude will be similar to that of the Kara-Kum desert. Another possibility is that reduction of atmospheric permeability will cause a new Ice Age. These

[1] The address has been shortened for editorial reasons.

changes will take only 5-10 years to happen, which is extremely fast. Such a global catastrophe will bring our civilization to an end.

Currently increasing development of northern territories poses an urgent question of preserving a balanced state of unique ecosystems in this region. The fact that global warming is especially strong in the Arctic and North makes this question even more acute. Future changes threaten to result in a global ecological catastrophe, which will put in danger not just northern peoples but the whole human civilization as well. Any ill-conceived interference that does not account for specific northern conditions and irrational use of natural resources will increase and speed up global warming.

It is crucial for us to establish international cooperation today in order to prevent disastrous consequences of global warming. For many years, Yakutia has collaborated with scientists from Japan, the US, Canada and several EU countries in research on global warming. It is worth mentioning an important role that research stations such as the International Biological Station "Lena-Nordenskiold" play in studying processes of global warming. Over ten years of its existence, IBS "Lena-Nordenskiold" has made an invaluable contribution to the Arctic research. Members of the station have taken part in various scientific projects on ecosystems study, monitoring, as well as in ecological scientific tourism in the delta of the River Lena. Scientific projects carried out at the station are very diverse, ranging from biological studies of certain species of birds to archeological, historical and ethnographical research. The station has become a kind of scientific research ground in one of the nodal Arctic regions, which is in the delta of the Lena River.

Ratification of the Kyoto protocol by the Russian Federation presents us with the task of reducing emission of greenhouse gases. There is a lot to do here, considering the fact that outdated technologies are still used in energy, housing and utilities sectors of the Republic. Implementation of new technologies in these spheres will allow reducing emission of carbon dioxide and methane as well as improving living conditions in the north. A social component is another strong reason for the implementation of modern technologies in Yakutian economy.

Social crisis has affected nearly every society. Such social diseases as drug addiction, alcoholism, prostitution and crime have hit both developed and developing countries. Organized crime has reached an incredible size and there are international mafia syndicates that control a considerable part of the world economy. Terrorism is another acute problem of the present.

The source of a social crisis lies in the fact that there are no real administrative ways of solving social problems today. History shows that mankind had built higher and higher administrative pyramids until it created global administrative bodies such as United Nations, World Bank and International Monetary Fund, as well as transnational corporations. Even an ultimately complex administrative pyramid closes on a single leader who is responsible for making decisions. Such a construction built upon a principle of hierarchical structure of collectivist primates is incapable of solving complex social problems. What used to work for a small group of individuals cannot be efficient in modern conditions. It is obvious that current pyramidal structure of society is undergoing a crisis.

Is there a way out of this situation?

People of the Arctic and North have built their civilization in rather severe climatic conditions. The region is characterized by vulnerable nature, low biological productivity and very low rates of natural regeneration. For centuries people that live in this severe region have existed in harmony with nature, following strict rules of nature management. Spiritual world of northerners is notable for its humanity and purity. Self-restraint and a decent way of life were combined here with unlimited spiritual and intellectual progress. Northern people worshipped Nature. Knowledge of laws of nature together with religious understanding of natural phenomena and adherence to Nature cult allowed them reaching a reasonable balance between the use of natural resources and their renewal. This knowledge has been passed on from generation to generation, which is why we have vast territories of pristine nature in Yakutia today. It was not until very recently that richness and depth of this knowledge of Nature and rules of being has attracted attention of "civilized" representatives of humanity that live in climatically more favourable regions of the planet.

An example of tradition that has been passed on for thousands of years is preservation of "holy lands". In Yakutia, the status of holy lands – "Ytyk Sirder" – was ascribed to lakes, mountains, forests and certain natural phenomena. Ytyk Sirder possessed a special status in a way that nobody had rights to extract resources, make noise, leave waste or conduct any economic activity there. With time, Ytyk Sirder have become the center of religious believes and place of worship. After many years of pursuing an illusive economic dream, Republic of Sakha (Yakutia) decided to restore the forgotten noble traditions of its ancestors. A state system of specially protected Ytyk Sirder territories was created in 1994.

It might seem that managing such massive territories of pristine nature is very difficult. However, the system based on the centuries-old wisdom and noble traditions of northern people has developed into a spontaneous and self-regulating structure. Even in remote communities, people started to create specially protected territories which they manage on a voluntary basis. An ecological and ethnographical zone was created in the village of Khoro in Suntarskii ulus. A similar structure exists in the village of Kurbusy in Ust'-Aldanskii ulus. This example shows that such structures based on centuries-tested traditions and people's experience are viable and promising.

The example of this severe region of White Silence shows that only infinite cosmos of knowledge is capable of saving humanity from a deadly grip of civilization crisis. Our only chance is to combine modern scientific achievements with centuries-old knowledge of laws of Nature and traditions of northern people in order to build the future society that will be able to transform biosphere into noosphere. The new worldview must take into account the fact that humanity is responsible for our Planet's destiny. The new worldview must be based on the principle of conscious and volitional restriction of material consumption, and have unlimited acquisition of information as its aim. Only then the way for spiritual development in harmony with Nature will open up for people. Supreme spirituality includes following the strictest rules of rational nature management and constantly improving one's knowledge of the Universe.

Education is one of the main sources of spiritual development today. It does not simply provide people with knowledge but also shapes their value system. Future of humanity depends on moral and spiritual education that is available for young generation nowadays. However, education today, as well as society in general, is in a state of crisis. Education system is aimed at training a consumer and leader. The ultimate goal of education is to raise a person that would aim at reaching the top of a hierarchical pyramid. Such practice is defective and is a vestige of the past when humanity lived according to laws of a primate band. The education system obviously needs to be reformed. First of all, education should aim at raising an individual that is ready for self-restraint in material consumption and for infinite spiritual improvement.

Work in these areas will give us an opportunity to bring the environmental protection in the Arctic and North at a new level. Through creating an international system of environmental protection based on moral principles of Arctic people and new understanding of the world, we will be able to build the basis for sustainable development of the region. This will serve as a mechanism of transforming a consumer-person into a wisdom-person that lives in harmony with the environment. Only then will it be possible to realize the great prevision made by Vernadskii, which is the creation of noosphere. The main link of noosphere will be People, Citizens of the Planet notable for their high spirituality, intellectual potential and ecological culture.

Thank you for your attention!

Opening address

By the President of the Arctic Ungulate Society,

Professor Arnoldus Schytte Blix

Excellencies, members of the organizing committee, ladies and gentlemen!

On behalf of the International Arctic Ungulate Society I have the great pleasure to express my sincere gratitude to the organizers of this most important scientific conference, which is the 12th in a series of conferences on arctic ungulates – that started 35 years ago.

I am particularly happy to be invited to Yakutsk, now that the conference for the first time is held in Russia, both because the Republic of Sakha is one of the major reindeer regions of the world, and because Siberia has always been a place of mystery and adventure, that we all have had a wish to go to.

And, finally, we are all here, with great expectations for a very productive meeting, where we, the foreigners, are particularly looking forward to discussions and exchange of ideas with all the Russian experts, whom we have been unable to meet at the previous conferences.

So, again congratulations, and thank you to the organizing committee, the Authorities of the Republic of Sakha, and all the other sponsors and supporters, for making this important meeting a dream come true!

Thank you!

View of the conference venue with some of the participants hard at work. Photo: R.E. Haugerud.

The conference in session with speaker Birgitta Åhman, Sweden and chairmen Mauri Nieminen, Finland and Leonid Kolpashikov, Russia. Photo: R.E. Haugerud.

Proc. 12th Arctic Ungulate Conference (AUC),
Yakutsk, Republic of Sakha, Russia,
8-13 August, 2007

Some results of implementation of the Program "Realization of the state ecological policy of the Sakha Republic (Yakutia) in the field of flora and fauna enrichment"

Некоторые итоги выполнения программы «Реализация государственной экологической политики республики Саха (Якутия) в области обогащения флоры и фауны»

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Abstract: Within the program, we worked on the block 1 called "Reacclimatization of muskox in Yakutia tundra zone" and block 2 called "Reacclimatization of bison in Yakutia forest zone". The aim of the work was to create viable populations of muskoxen and bisons.

During 1996, 1997, 2000, 2001 and 2002 we translocated 101 muskoxen from the territory of Vostochnyi (Eastern) Taimyr to Bulunskii (24), Anabarskii (66) and Allaikhovskii (11) raions (districts). The total population made up approximately 350 heads for the whole period.

Adaptation process has been particularly successful among six months old muskoxen in Allaikhovskii. Two female muskoxen strayed away from the main group after the resettlement and rejoined it in summer 2006. Muskoxen are to be found 40 kilometers to the north-west from the village Chokurdakh. The animals do not go far from that place. The litter made up 5 calves in 2003, 7 in 2004, 6 in 2005, 7 in 2006 and 14 in 2007. Today, there are 50 muskoxen in Allaikhovskii raion altogether, among them all the calves born this year, 5 animals born last year, 17 adult females, 6 adult males and 8 young animals.

Thirty forest bisons were resettled from "Elk Island" National Park of Canada to the nature park "Lenskie Stolby" in Yakutia in April 2006.

Three animals died during that year: one was mortally injured during transport; another died as a result of veterinary measures; the third one died by unknown reason. The rest of the bisons survived the winter well. The fenced territory for the bisons is being increased up to 80 hectares.

We have considered several territories that are suitable for further resettlement of bisons within the Republic. The most suitable territories are the basin of the River Orto-Salaa (Kobiaiskii raion), Ozhoginskii dale at the border of Srednekolymskii, Verkhnekolymskii, Momskii and Abyiskii raions and the nature park "Siniaia" in Gornyi raion.

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Present status, monitoring and research goals: wild reindeer of Taimyr population

Современное состояние, мониторинг и задачи исследований диких северных оленей таймырской популяции

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Abstract: Taimyr population of wild reindeer is the biggest in the world. It is a geographically and ecologically unique phenomenon in terms of its size (about 1 000 000 animals in 2000), range of migration (up to 1500 km) and use of vegetation zones (from northern taiga to polar deserts). The main feature of the population is its spatial and geographical unity. Today the population occupies a vast territory in the north of middle and partly western Siberia which makes up 1 500 000 km^2. Within this territory the animals are distributed unevenly and unstably due to their regular large scale migrations and seasonal availability of pastures.

Current changes in Taimyr population of wild reindeer are intensified under increasing pressure from, especially uncontrolled, hunting and negative impact of other anthropogenic factors. The latter causes significant qualitative changes within the population.

Historically, wild reindeer have played a crucial role in traditional nature management of Taimyr aboriginal peoples. Introduction of commercial reindeer herding in the Yenisei North has determined further changes in size, age-gender structure, direction of migration, and to some extent genetic structure of the wild reindeer population. Taimyr population became an object of control during the period of commercial reindeer herding (1971-1991). Since 1971 the population has lost more than 1 900 000 wild reindeer which exceed significantly the current population's size.

Drawing on our data, we suggest that the current population of wild reindeer in Taimyr has either reached the limit of its habitat's ecological capacity or is near it. The expansion of Taimyr population's habitat is close to its end due to restricting biotic, abiotic and anthropogenic factors. We have observed changes in spatial structure of the population and local degradation of pastures. Epizootic situations within the population's habitat have also become more problematic. Besides this, there has been a growing pressure from commercial (poaching) hunting on Taimyr population of wild reindeer. Illegal production of things made of young reindeer's antlers is very widespread. Antlers are usually cut off from live animals when they cross rivers. Killing of best bulls during hunting season and procurement of young reindeer's antlers have had a negative impact on the population.

An important issue about Taimyr population of wild reindeer is its space-time structure. Past few years witnessed a shift of population's winter and calving places eastwards and southwards with a simultaneous expansion of the initial habitat. The main feature of wild reindeer's migration is a seasonal change of places which is an essential adaptation to Arctic living conditions.

Anthropogenic factors also have a big impact on territorial distribution of animals. Factors such as gas pipelines Noril'sk-Messoiakha-Peliatka, winter navigation on the Yenisei River and kilometers-long fences for hunting reindeer disturb natural migration routes of the animals, increase their natural mortality and have a negative impact on reproduction abilities of the population.

The commercial reindeer herding system obviously needs to be changed and improved under current market conditions. It is necessary to organize a strict control over all types of hunting activities within the habitat of wild reindeer, including Taimyr, north of Evenkiia, Iamal and western regions of Yakutia. It is necessary to improve the existing ones

and develop new resource-saving technologies of hunting and slaughtering wild reindeer. The research should be conducted along the following lines:

· studying demographic and morpho-physiological parameters of main groups and migration routes of the population;
· predicting the spatial structure of the population under global climate change;
· studying spatial and genetic structure of the population;
· observing state of pastures within the population's habitat.

To meet these tasks we need new equipment and information technologies that would be more efficient and less expensive compared to the ones we used before. Monitoring data provide information support for GIS and modeling systems that altogether create a scientific base which would allow hunting experts, ecologists and managers to protect and develop sustainable use of resources of the unique Taimyr population of wild reindeer. In order to carry out monitoring, it is necessary to build field stations and develop regional ecological monitoring service within the habitat of Taimyr population of wild reindeer.

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CARMA – circum-arctic *Rangifer* assessment and monitoring network

CARMA – циркумарктическая оценка популяций северного оленя и сеть мониторинга

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Abstract: The Carma Network was established to encourage an active interchange of ideas and data on the world's *Rangifer* herds. Representative from the circumpolar countries have held three annual meetings to help launch the Network. Based on this collaboration, CARMA is now poised to participate in the International Polar Year initiative, primarily based on funding obtained through the Canadian YPI Committee. This paper will discuss the origins of the Network, the principles established and a detailed discussion of the objectives of CARMA during the IPY period.

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Veterinary safety in the Russian Arctic

Ветеринарное благополучие арктической зоны России

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Abstract: A range of zoonotic diseases have been registered among ungulate animals in the Arctic, such as anthrax, rabies and brucellosis. For anthrax, the main danger lies in existence of old centers of anthrax infections which can be found all over the Russian north. The problem of brucellosis among both wild and domestic reindeer has not yet been resolved.

Researchers in Yakutsk Agricultural Research Institute (YaARI) developed various vaccines to use as preventive measures against infection. But the existence of natural centers of infection makes efficient vaccination difficult. In spite of all measures, necrobacillosis, especially among domesticated reindeer, causes big damage to reindeer husbandry every year.

There is a particular arctic version of rabies called '*dikovanie*' which is common among arctic foxes and dogs. Therefore the chances that infection will spread again still exist.

Warble bot flies and nose bot flies cause much damage to reindeer herding. Researchers in YaARI have studied the biology of bot flies and developed ways of dealing with them with the help of insecticides and repellents. Parasitic diseases among reindeer, horses and wild ungulates still present an unresolved problem although scientists have studied their biology and spread of main helminthiases. Another problem is bronchopneumonia among young reindeer which sometimes kills up to 30% of animals. Recently we have observed circulation of infectious rhinotracheitis and diarrhea viruses in some regions of Yakutia. Migrant birds must play an important role in spreading these diseases.

Infectious diseases such as strangles, salmonellosis abortion, rhinopneumonia and leptospirosis prevent stable development of horse breeding in arctic regions. Researchers in YaARI have been the first to develop vaccines against strangles and salmonellosis abortion. They are also working on an inactivated vaccine against rhinopneumonia, or a virus abortion. These new medicines have been registered in the Russian Federation.

Scientists in YaARI have not only developed a new probiotic called 'Sakhabiaktisubtil' which is used as a preventive measure and medicine to treat disbacteriosis, endometritis, mycotoxicosis, and used as an immuno-simulative component in other vaccines and ferment composition of mineral and vitamin supplements, but as well developed antibacterial medications and immuno-modulators based on probiotic elements. We are also working on mineral and vitamin supplements for reindeer, horses and cattle taking into account geochemical composition of soil in different regions, and we are developing and putting in practice technologies for processing reindeer herding and horse breeding products such as antlers, blood, milk, endocrine organs, meat and by-products as they are used in food industry and in production of dietary supplements and medicines.

Dietary supplements and medicines designed both for animals and people must be of a natural origin and not contain genetically modified components and living cultures of microorganisms' pathogenic strains. Development of natural immuno-modulators and consideration of each organism's immuno-biological composition when applying them will allow increased efficiency of treatment and preventive measures.

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The composition of reindeer meat

Состав мяса северного оленя

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Abstract: There are about 3 million reindeer in the world and each year nets approximately 20 million kilograms of reindeer meat. In Finland, reindeer are slaughtered in the autumn and early winter when body condition is favourable. Approximately 120 000 Finnish reindeer are slaughtered every year resulting in 2-2.5 million kilograms of meat annually. More than 75% of the animals slaughtered are calves, 18% adult females, and 6% adult males with individual meat yields of 20-25 kg, 35-40 kg, and 50-60 kg, for the respective classes. Reindeer destined for the annual harvest do not receive supplemental winter feed. The diet of the animals surviving over winter usually consists of hay, silage and commercially produced fodder and natural vegetation obtained from free-range grazing, with the exception of Pohjois-Salla reindeer herding cooperative which does not administer supplemental winter feed. During the autumn slaughter, 46% of calf body weight is sold as meat (slaughtered weight versus live weight). When calves receive supplemental summer fodder (crude protein 21%) during the summer and autumn, their body weight increases more than calves grazing entirely on natural pastures. The increase in body weight is attributed to an increase in organ and muscle mass. The average per cent of body meat from reindeer grazing on natural vegetation was 72 for calves and 70 for adult females (meat weight *versus* slaughtered weight). However, when calves received supplemental feed, the percentage of body meat was 75%.

Reindeer meat is high in protein and it contains many essential amino acids. The rump and calf muscles especially are protein rich. In the autumn, calf fillet contains an average of 23% protein, which is typically higher than that of adult female reindeer. When reindeer are supplemental fed in the summer, autumn, and occasionally at other times of the year, the protein concentration in meat increases. The highest concentration of protein is found in the entrails, including the liver, heart and thymus. Reindeer meat is low in fat. Calf fillet contains an average of only 2.3% fat. Castrated male reindeer contain most fat in winter (5.4%) when their diet consists of fodder, and in autumn when they graze naturally on pastures (12.2%). Body condition degenerates quickly over winter when fat and protein reserves are consumed. The average water content in meat from adult male reindeer is 64% and 72-75% in calves. There is very little fat in inside fillet and reindeer rump. Highest fat content is found in the tongue, outside filet, neck strap, and chest. The fat content in calf meat and internal organs increases when they consume supplemental feed in summer and autumn.

The composition of reindeer fat includes mostly unsaturated oleic acid (18:1), saturated stearic (18:0), and palmitic acid (16:0). In autumn, calf fillet is rich in oleic acid (29.8%) and the thymus gland, too. Reindeer lichens consist of monounsaturated fats which are high in oleic acid. Oleic acid decreases blood LDL-cholesterol. Monounsaturated fats are abundant (31.6%) in calf fillet during the autumn. Poor body condition decreases monounsaturated fats, particularly oleic acid. The average of saturated fatty acids in calf fillet is 41.6%, and of this, stearic acid (37.3%) has no affect on blood cholesterol. Palmitic acid (22.5%) elevates blood LDL-cholesterol, and total cholesterol level is 72mg/100g in calf fillet. During the autumn, calves grazing on predominantly natural vegetation have high levels of polyunsaturated fatty acids and also P/S- continued values (polyunsaturated/saturated fatty acids). The concentration of polyunsaturated fatty acids in calf fillet is 15.3% and omega-3 fatty acids (18:3, 20:5, and 22:6) 2.6%. Linoleic acid (18:2) is essential in the human diet. Reindeer meat consists of an average of 9.1% linoleic acid. Calf fillet contains sufficient polyunsaturated/saturated fatty acids with average ratio of 0.37. Calf fillet is low in carbohydrates (0.3%), however, the composition of fine-grained reindeer meat has considerably higher energy levels. The average level of energy in reindeer fat is 34.5 MJ/kg, and low-level fat in calves is less than in adult reindeer.

Reindeer meat contains a variety of vitamins, including the important B-group vitamins. Vitamins are more numerous in reindeer calf meat and internal organs than in adult female reindeer. Internal organs are high in riboflavin and niacin.

Liver is rich in vitamin A and E and the internal organs contain a lot of vitamin C. Meat is also high in riboflavin, niacin, and vitamins C and E. Reindeer meat is also high in mineral and trace elements. Ash content in meat and internal organs is marginally higher in calves than in adult female reindeer. Reindeer meat and internal organs are rich in magnesium and potassium, and calves exhibit higher levels than adult females. Use of supplemental feed increases mineral and trace elements, especially the iron content in meat and entrails. The mean iron content in calf fillet is 3.2 mg/100 g. Iron content in meat is slightly higher in adult females compared to calves, but calves have greater stores of iron in their internal organs. Supplemental feed offered to calves during the summer and autumn increases the iron content in meat, kidney, and tongue. Reindeer meat and liver are rich in selenium. Heavy metals are low in Finnish reindeer meat. However, cadmium (Cd) and lead (Pb) have been detected in reindeer liver and kidney. Reindeer research showed that the low concentration of Cs-137 in meat substantially decreased when animals were fed year-round with commercially produced fodder. Reindeer meat is of the utmost high quality, providing an excellent and healthy source of nutrients and vitamins.

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Number and economical importance of tundra wild reindeer in Yakutia

Численность и хозяйственное значение тундрового дикого северного оленя в Якутии

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Abstract: There are three tundra populations of wild reindeer that are of main economic importance in Yakutia. They are iano-indigirskaia, sundrunskaia (indigiro-kolymskaia) and leno-anabarskaia (bulunskaia) populations. Iano-indigirskaia and sundrunskaia populations used to belong to one large population as they shared a range of ecological and morphological features. They occupied the territory between the rivers Iana and Kolyma. Leno-anabarskaia population used to be continuously with the Taimyr population. The populations established their current habitat area last century.

The total number of wild reindeer in inland tundras in Yakutia made up 70 to 80 000 animals in 1963-1965. By 1985-1990 it increased up to 240 to 260 000 animals and went down to 140 to 150 000 animals by 2000. The sharp increase of reindeer number in the 1960s was due to populations' highly productive age-gender structure (the ratio of adult male to adult female reindeer was 1:2.6-3; share of calves made up 27-28%) and their intensive reproduction. By 1970-1980 the populations' overall habitat increased up to 900 000 km^2 and covered almost all the northern regions of the republic.

The size of populations increased together with their economic importance. Intensive commercial hunting of wild reindeer began at the end of the 1960s and soon played an important role in agricultural production. In the 1980s wild reindeer hunting in northern regions equaled with domestic reindeer herding in terms of meat output. In regions with many reindeer, wild reindeer hunting was superior to domestic reindeer herding being six times more productive for equal labour, with 21% lower prime cost and 24% higher profit from meat trade.

Occasional negative impact of wild reindeer on domestic reindeer herding in northern regions was paid off with high meat output and other advantages of hunting. Virtually two fully developed fields of economy coexisted in the north of the republic during the 1980s, supplying the local population entirely with meat, skin and fur production. About 500 000 wild reindeer were hunted with licenses for the period 1985 to 2000. Many animals were also hunted illegally to cover needs of local populations. Development of wild reindeer hunting in Yakutia went through several positive and negative stages. Rationalization of hunting at the turn of the 1990s had a great positive effect. A population approach to setting hunting limits came into force. Hunting management and system of hunters' reporting improved. A method for hunting reindeer with the help of portable net fences was successfully put into operation. Ecologically based limits for hunting period and regular killing of adult male reindeer decreased hunting pressure on female reindeer, optimized demographic structure of populations and intensified reproduction of wild reindeer.

Due to a crisis of domestic reindeer herding in the middle of the 1990s, economic use of wild reindeer played an especially important role in providing northern regions with meat. However, ecological principles of hunting reindeer were hardly followed during that period. Due to increased hunting pressure, the size of the biggest iano-indigirskaia population decreased; 1987: 130 400 animals, 1991: 101 400, 2000: 42 100 and 2002: 34 000 animals. The ratio of adult male to adult female reindeer shifted to 1:0.9, reproduction slowed down and share of calves went down to 13.8-15.5%. Sundrunskaia population is in a similar situation; 1993: 39 900, 1996: 34 000 and 2002: 28 500 animals. Leno-anabarskaia population still looks promising for commercial hunting as it increases due to immigration of Taimyr population reindeer. In 1988 it had 73 000 reindeer, in 1994: 77 800 and in 2001: 90 000 reindeer.

In 2000-2006, the share of wild reindeer meat reached up to 68.6-99.1% in total amount of animal husbandry production in many northern agricultural regions. Preservation of size and increase of productivity of hunted populations of wild reindeer is an important social and economic problem in this region.

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State and problems of domestic reindeer herding in Russia

Состояние и проблемы домашнего северного оленеводства в России

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Abstract: Russia has got the largest reserve of reindeer pastures in the world which is 328 million hectares. The most northern domestic reindeer herding economy has been in crisis for more than 15 years by now. During this period, the number of domestic reindeer decreased from 2 260 000 animals to 1 340 000. Still Russia has got more than half of all domestic reindeer in the world.

While the number of reindeer in Evenki Autonomous District decreased by 83% in 1998 as compared to 1991, the number of indigenous people there decreased by 20%; the decrease made up 71% and 39% respectively in Magadan oblast, 68% and 44% in Chukotka Autonomous District and 58% and 19% in Koriak Autonomous District. The situation finally got better when a federal resolution "Additional measures of state support towards northern reindeer herding in 2000-2005" signed by the president V. V. Putin came into force.

For the past three years of 2004 to 2006, domestic reindeer population stopped decreasing and even showed a tendency to increase in several reindeer herding regions (Sakha Republic (Yakutia) and Chukotka Autonomous District), which was due to the federal and regional support. However, in order for reindeer herding to regenerate and reindeer herding people to feel socially and economically secure, a more substantial support from the state is needed. This support should take into consideration both regional and national features of reindeer herding economies.

In the year 2000, we developed a pilot program where we suggested dividing reindeer herding regions of Russia in three zones:

1) a zone of sustainable development (European North: Komi Republic, Murmansk and Arkhangel'sk oblasts, Nenets and Iamalo-Nenets Autonomous District) where reindeer population decreased by 30%;
2) a zone of a sharp decrease of reindeer population (Khanty-Mansiisk Autonomous District, Krasnoiarskii Krai, Magadan, Kamchatka and Amur oblasts and Sakha Republic (Yakutia)) where the decrease made up 60%;
3) a zone of disappearing reindeer herding where less than 20% of reindeer population remained (Chita, Irkutsk and Sakhalin oblasts, Tyva Republic, Buriatiia and Evenkiia).

The main concern for the first zone is procurement, efficient processing and trading of reindeer herding produce; for the second zone, the concern is to improve reindeer herding management, preserve and restore reindeer population; finally, the third zone is concerned with switching to a new system of keeping reindeer herds within fences, providing reindeer's safety, creating work places and providing social protection for reindeer herders.

In order to meet these concerns, we should pass the federal resolution "About reindeer herding" as well as approve the Program, the pilot version of which was suggested firstly in 2000. It was then revised after a meeting held by the board of Ministry of Agriculture in Yakutsk in 2006.

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Effect of forest harvesting on the usability value of pasture land for reindeer in northern parts of Finland

Воздействие рубки леса на хозяйственную ценность оленьих пастбищ в северной части Финляндии

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Abstract: About two third of the reindeer herding area in Finland belongs to the commercial forest area, where forest harvesting has considerably affected the structure of forestland pastures. There are continuous disagreement between forest industry and reindeer herding, how forestry operations, in fact, change the usability value of reindeer pastureland. Reindeer herders assure that forest openings do not only destroy arboreal lichen pastures (old growth forests) but also reduce amount of terrestrial lichens and disturb winter grazing of reindeer, since felling residue cover soil surface and snow conditions may change more difficult in felling areas than in untouched old growth forests. Besides these things, forest openings and forest roads may split a continuous winter pasture areas which makes reindeer herding more difficult than before. On the other hand, forest thinning may improve growth conditions of terrestrial lichens since light increases on the bottom layer of vegetation. Also amount of hays and grasses may considerably increase in submesic forest openings after cutting which then offers plenty of green fodder for reindeer.

In order to clarify the effects of forest harvesting on the winter grazing value of pastureland we studied the use of forestland pastures by reindeer in two reindeer herding districts located in northern boreal coniferous forest area in Finland. Selection of winter home range areas and pasture types by reindeer were studied by tracking reindeer with GPS collars and analysing these locations with the Compositional Analysis. Altogether 29 females were tracked in the Ivalo district during 1999-2002 and 40 females in the Oraniemi district during 2003-2006. In the Ivalo district, which is located in the pine forest area, the reindeer preferred old growth forest (both lichen and hay dominated) and avoided felling areas and linear infrastructure (forest roads and power lines) in the selection and use of their wintering areas. Old growth pine forest had high preference value especially in late winter. However, during early winter season when snow conditions were still relatively easy, the study reindeer in the Ivalo district also used sapling stands and young cultivation forests. In the Oraniemi district which is located in the spruce forest area and where old growth forests are more fragmented than in the Ivalo district, the reindeer did not show so clear preference to old growth forests when selecting winter home range area. However, when using winter home range areas reindeer clearly preferred old spruce forests and avoided young and dense mixed forests. Use of both lichen and hay dominated felling and sapling stand areas were also relatively high in winter home range areas. In late winter reindeer were much gathered to the areas just logged down to forage arboreal lichens from crown and branches of felled trees.

The net energy balancing–hypothesis including the total energy profits and expenditures could primarily explain habitat selection by the study reindeer during winter in these intensively grazed and logged forest areas. In this kind of areas reindeer clearly have a shortage of energy rich lichens in winter. In our study areas, availability of both terrestrial and arboreal lichens was most advantageous in old growth forests and therefore reindeer preferred these forests especially in late winter when grazing conditions were most difficult. It is therefore obvious that maintaining a certain amount of old growth forest and minimising linear infrastructure in wintering areas of reindeer considerably improves the suitability of these ranges for reindeer herding.

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Energy expenditure in reindeer as an integral bioclimatic index

Энергопотери организма северных оленей как интегральный биоклиматический показатель

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Abstract: Weather and climate are the most important ecological factors that determine state and change of arctic ecosystems. Reindeer developed the following physiological and behavioral adaptations under extreme climatic conditions: a thick heat-insulating layer of fur, accumulation of fat tissue and vast seasonal migrations accompanied with changes of food range. These adaptations reduce but do not fully eliminate negative impact of environmental factors on reindeer.

The impact of weather and climate conditions on reindeer is reflected first of all in the amount of energy that reindeer spend on heat emission, physical activity and main energy exchange depending on heliophysical, meteorological and morphophysiological functions of an organism. A crucial thing here is that heat flows are balanced according to the energy conservation law.

Spatial and temporal distribution of energy expenditure depending on actinometric and meteo-factors makes up population's bio-climatic habitat. Locating optimum and minimum zones within an energy expenditure field allows us to determine climatically favourable and unfavourable regions within the habitat. This information together with data on food resources, relief and anthropogenic impact provide a basis for studying and predicting spatial distribution and migration of reindeer population. We should note that the time when blood-sucking insects both appear and become most active is determined by weather and climate conditions.

In order to build a habitat's bio-climatic field, we need both weather and climate data and biological data on reindeer's energy expenditure. We have developed a two components computer model to automate counting procedures. The first component is an information model of habitat's climate that contains time series of actinometric and meteo-data. The main concern here is to select data to build a computer database that would be suitable for conducting bio-climatic calculations. The second component is a model that correlates reindeer's energy expenditure with main weather and climate factors such as air temperature, wind speed, solar radiation, fog, cloud, and snow condition. The energy expenditure model is based on equations for calculating full metabolic capacity of an animal, on thermal conductivity equations and universal biological principles. Modifying the model when appropriate, we can use it for studying various species of ungulate animals. We created the computer program because opportunities for direct measurement of reindeer's energy balance are restricted and not enough for building bio-climatic fields within a real range of weather and climate conditions.

With the help of modeling, we estimated the structure of the bio-climatic field of Taimyr wild reindeer population's habitat. We discovered that in winter the energy field of the habitat, estimated according to average January data and with consideration of all main weather and climate factors, is considerably different from the temperature field. Unlike isotherms that follow the continental boundary, energy isolines cross it almost at the right angle, which speaks for an important role of non-temperature factors in the formation of the field. As the north of the habitat is close to the ocean, it has higher temperatures than the south and south-east where the minimum of the field is located and where main groups of animals spend winter.

The energy expenditure model can be also used for conducting computer experiments on estimating quantitative impact of meteo-factors on wild reindeer's energy expenditure and for revealing unfavourable combinations of factors that lead to overcooling or overheating of an organism and decrease of reindeer's feeding activity and that force animals to migrate. For example, the modeling helped us to discover that animals may have a heat stress caused by solar radiation in zones with tolerant and negative temperatures, which had been unknown before.

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Possible effects of summer calf marking on energy budgets and body mass of semi-domestic reindeer

Возможное воздействие летней маркировки телят на энергобюджет и массу тела полуодомашненного северного оленя

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Abstract: We have studied activity patterns of reindeer at calf marking during one summer in a reindeer herding district in central Sweden. We also followed the movements of seven adult female reindeer, equipped with GPS collars, before and after calf marking. The aim was to examine to what extent calf marking changed the activity of the reindeer before, during and after the gathering and marking procedure. The collected data was used to calculate possible changes in energy intake and expenditure and, further, to simulate the effect of calf marking on live body mass and production of the animals.

Preliminary results show that calf marking increases the activity of the reindeer during one to three days prior to marking, when the animals are gathered from the mountain. The actual marking of calves took six hours, on average, per group of about 600 animals. During marking, running increased to about 25% of the time, compared to around 5% observed in undisturbed animals. The time spent walking was about the same, whilst the amount of time spent standing or lying was substantially lower during marking compared to when the animals were undisturbed. When the reindeer were released from the coral, it took up to five hours for before the animals seemed to have returned to an undisturbed activity pattern.

The increased activity, and decrease in grazing time, caused by one calf marking event resulted in an estimated reduction in autumn (November) empty body mass at 0.1 kg for the calf and 0.3 kg for the female. In many herding districts, calf marking is repeated at several occasions during the summer to make sure that all calves are marked. Together with other disturbances, this may result in a significant reduction of production in the reindeer herd.

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Traditional ecological knowledge of the reindeer-herding Sami in northern Sweden relating to the vegetation upon which reindeer graze

Традиционные экологические знания о растительности пастбищ у саамов на севере Швеции

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Abstract: This study is based upon the reindeer herders' traditional ecological knowledge about what vegetation the reindeer graze on throughout the year. Their knowledge of the vegetation the reindeer graze on is considered important for reindeer herders in their work. Seventeen reindeer herding Sami, born before 1950 and from four different Sami villages (Udtja, Girjas, Leavas and Gabna), in northern Sweden, were interviewed to identify 40 vascular plants which have been identified in scientific literature as vegetation upon which the reindeer graze, as well as to indicate whether they are certain that the reindeer do use it for grazing and what time of year that occurs. The informants identified twenty-one plant species and five plant families. They especially paid attention to the plants they themselves used as i.e., Norwegian Angelica, *Angelica archangelica archangelica*, but also special grazing plants such as Water Horsetail, *Equisetum fluviatile*. Species which reindeer herders identified as plants which reindeer grazed on are also reported on in scientific literature. The group of grasses which are called sitnu by all the informants was said to be green in the winter and almost all of them said that it was grazed on even during the wintertime. There was insignificant detailed knowledge of vascular plants and only a few were named by several reindeer herders.

The reindeer are among the few animals which graze on lichens and which can assimilate this energy-rich vegetation. To determine if knowledge on plants which the reindeer prefer to graze on in the winter is larger than that about the green plants grazed on in the summer the same group of reindeer herders were interviewed (with a few exceptions) about lichens and mushrooms.

The questions were:
a) What Sami word is there for lichens and mushrooms?
b) When do the reindeer graze on mushrooms and lichens?

The majority of the informants differentiated between the various lichen species and had Sami names for them. The Sami names of lichens follow a given nomenclature and differ from lichens living on the ground (jeagil, visste), hanging lichens (lahppu, slahppo) and foliose lichens and crusted lichen on stones or trees (gatna, gadna). According to all the informants, reindeer graze on lichen while the snow is on the ground, but they can also graze on lichens in the summer when it is cold and humid. This has also been confirmed in scientific literature. In terms of mushrooms, there is only one Sami word for mushroom and none of the informants had any interest in differentiating the various mushroom species. All the informants said that the reindeer graze on mushrooms and could also indicate what part of the year they did so. They also also said that reindeer like mushrooms and that reindeer are hard to round up for slaughter in September if there are lots of mushrooms.

In a little experiment, a group of nine informants were asked to study seven boxes which had lichens in differing quantities and with different species of small shrubs and other plants which they were asked to rank in terms of good winter grazing. As well as ranking, they commented upon how humid or dry the ground would be with these plants,

and what part of the wintertime they would let their reindeer graze in such an area. In a second experiment, the herders' were shown two photographs: one from a forest dominated by *Pinus sylvestris*, with trees of different ages, and one from a forest of *P. sylvestris* with mainly large trees in a slightly rolling terrain and with boulders covered with lichens. The herders' were asked to value the two habitats as winter grazing areas with the assumption that both had the same amount of fodder (both in quality and quantity). In this exercise the importance of snow for winter grazing was indicated as the informants ranked the different boxes with lichens and as they commented on the two photographs.

The conclusion is that the reindeer herders' knowledge of the grazing habits of the reindeer are more detailed for the plants grazed on during the wintertime. This can be explained generally by the fact that there is a closer contact between the herder and the reindeer in the winter than during the summer. Tame reindeer (heargi) that in years past (before the 1950s) were used as draught animals and kept in pens or on a rope in the wintertime were free with the rest of the herd in the summertime. Knowledge about the summer grazing plants was not as important, either, since the reindeer find their food themselves at that time of the year. In the wintertime the herder actively moves the reindeer in small herds to different grazing areas. In the winter it is certainly more important for the reindeer herder to know which plants the reindeer prefer since they have to choose an appropriate place for grazing. In this study I have not actively discussed the importance of the snow with the informants, but they themselves have brought up its importance. The conclusion is that snow is probably the most important factor when the reindeer herder chooses an area for winter grazing.

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Reindeer behaviour as a basis for management

Управление поведением северных оленей

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Abstract: Knowledge of reindeer behaviour is important for hunters, reindeer herders and builders as for the latter to avoid conflicts that arise during industrial development of territories. Reindeer behaviour based management is part of local people's knowledge but very few of its components have been tested in scientific experiments. We have only oral description of the majority of them.

In order to solve conflicts that arise during industrial development in the north, it is necessary to have detailed knowledge of migratory routes of reindeer from each population. These routes are determined by the location of seasonal pastures, especially summer and winter pastures, by reindeer's orientation in landscape and by traditions of each population. So far, we have gathered considerable amounts of data on reindeer's migratory routes only in Taimyr and Yakutia. Distances and intensity of reindeer's reaction towards industrial objects and transport determine parameters for building pipelines, roads and for transport operation. We consider it necessary to test in Russian conditions the parameters for building pipelines that have been accepted in northern America, such as 152 cm minimum height above the ground in places of reindeer's migration and 250 cm in places of most intensive movement of animals; roads and transmission lines that run parallel to each other must have at least 305 m between them; aircrafts must fly at more than 600 m height during calving period and 300 m height during the rest of the year; speed limit for cars is 24 km per hour on roads that go through calving pastures.

Upon meeting a technical structure, transport or people, reindeer react according to their defensive behaviour which is different for each population. Reindeer defensive behaviour is characterized by distance at which they can detect a danger and by frequency of their looking around (these are parameters of reindeer's vigilance), by their run away distances or distances to avoid people and constructions (parameters of reindeer's fearfulness) and by defensive behaviour strategies such as keeping a safe distance, making stops while running away, running away without stopping and change of territory on a daily basis.

Vigilance of wild and domestic reindeer defined by the distance at which they can detect a human being varies considerably (a proved interval is from 250 to 512 m). Frequency of looking around ranges from 7 to 15 times per hour. Reindeer's fearfulness defined by the distance of their first escape from an approaching human being varies from 140 to 450 m, which is a proved interval. Intensity of a pursuit by a human being is the main factor that determines both reindeer's vigilance and fearfulness. Reindeer's defensive behaviour strategies vary depending on the number of repeated approaches by a human being or amount of hunting carried out during a day. Having measured level of vigilance and fearfulness of wild reindeer from different populations, we found that the intensity of hunting has the biggest impact on both of them reaching up to 40%.

Many generations of northern peoples have contributed to the body of knowledge on pasturing. Animal behaviour science today can formalize the ways of pasturing that herders learn from their elders, then analyze them and finally reduce them to graphic models. Reindeer herding management requires knowledge of animals' motivation at a given moment, of environmental stimuli, signals from human beings and reindeer's reaction to all these. Scientific description of this knowledge implies making lists of reindeer's motivations, stimuli and reactions and providing characteristics for each of these elements. After that, we develop graphic models that can be used for teaching young herders. It is also necessary to know distances of reindeer's reaction to human beings and their signals.

Reindeer herding management is based on using regularities of reindeer social behaviour, which includes hierarchy, distances among animals and age and gender distribution within a herd. Reindeer herds often have many animals characterized by a free choice behaviour, i.e. leaders. However, their distribution within a herd is uneven, with young animals prevailing in the front part of a herd and female reindeer with calves and adult reindeer as potential leaders being located in the back part of a herd. Different ways to turn a herd, make it stop or go rely on knowledge of a herd's structure. There are special ways of making one potential leader leave the herd and then lead it. There are also ways to regulate a daily rhythm of pasturing in order to provide best foraging for reindeer.

The publication of a guide on reindeer behaviour-based management would contribute to preventing the decline of reindeer herding. There is also a need for a guide for builders that would summarize the existing experience of solving industrial development conflicts and preserving reindeer population.

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Monitoring wild reindeer in western Chukotka

Мониторинг диких северных оленей западной Чукотки

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Abstract: Central Chukotka population of wild reindeer has been growing dramatically fast. It increased from 30 000 reindeer in 1970-1980 to 159 000 in 1997, whereas the number of domestic reindeer declined from 491 000 in 1990 to 149 000 in 1998.

There are many reasons for the increase of the wild reindeer population: a) dissolution of domestic reindeer herds during an agricultural crisis that followed the reorganization of kolkhozes and sovkhozes; b) collapse of the system of wild reindeer meat procurement and processing; c) increase of Chukotka wild reindeer population due to immigration of reindeer from the Yakutia sundrunskaia population that resumed the migration to the right bank of the River Kolyma, the way it had done in the end of the 19th century.

A wild reindeer monitoring project started in Chukotka in 2003, for the first time involving not just scientists but also reindeer herders and hunters from three Chukotka regions and Nizhnekolymskii ulus (district) of Sakha Republic (Yakutia), as well as concerned state and municipal organizations.

The monitoring system consisted of reindeer herders and hunters (15 people altogether) conducting observations on the land, filling in diaries and charts. Their data was passed to regional coordinators that in turn passed it to analysts in Anadyr'. The processed data was then passed to relevant state and municipal organizations. The integrated monitoring information was returned to reindeer herders and reindeer herding farms' managers. Such an approach is useful for domestic reindeer industry when it tries to avoid conflicts between wild and domestic reindeer herds.

The monitoring project led us to several discoveries:

1) Central Chukotka population of wild reindeer has relatively permanent calving places and summer pastures, the majority of which occupy the territory of Anadyr' plateau in the upper reach of the River Anadyr' and near El'gygytgyn Lake. As the population increased, so the calving places and summer pastures expanded westwards. During the period from 2003 to 2005, a big group of wild reindeer remained in the same place called Topolevoe during both summer and winter, which resulted in pastures being severely trampled down. The summer pastures boundary extended to the upper reach of the River Oloi, which is more than 300 km away from reindeer's main summer territories.
2) Winter distribution of central Chukotka wild reindeer population has also undergone considerable changes. In the beginning of the 1990s, the majority of reindeer spent the winter in the valley of the River Belaia, which is 100 to 150 km to the south from the main summer territories in the upper reach of the River Anadyr' and near El'gygytgyn Lake. In November 1998 after the rainy season, the majority of reindeer moved to the south reaching the Rivers Main and Algan (400 km) and to the south-west up to the Rivers Iablon and Eropol (250 km). These territories remained the reindeer's main winter places until the year 2000. Since 2001 reindeer have migrated westwards reaching the middle course of the Rivers Malyi Aniui and Bol'shoi Aniui and the River Oloi (450 km).
3) In the beginning of the 1990s, reindeer herders of "Torvagyrgyn" reindeer farm in Nizhnekolymskii ulus observed intensive migration of separate wild reindeer groups and herds across the River Kolyma above Kolymskoe village and further across the River Omolon. Perhaps, it is this phenomenon together with other factors that has led to a dramatically rapid increase of Chukotka reindeer population.
4) We have registered morphological changes among wild reindeer, such as rounding of reindeer hooves. We think that this phenomenon is not a result of environmental factors but an outcome of partial crossing between wild and domestic reindeer.

5) According to Zheleznov (1990), there is a local Main population of wild reindeer in the south of Chukotka near the village Vaega. However, according to our observers (D'iachkov), there are two separate reindeer populations on a small territory (22 500 km^2) between the villages Vaega and Markovo: reindeer of a yellowish colour on the River Orlovka and smaller reindeer of light-grey colour on the River Algan. We also have data on lake wild reindeer.

Indigenous peoples in Chukotka have accumulated a vast amount of traditional knowledge about wild reindeer, which speaks for centuries-old relations between arctic people and wild reindeer. Pegtymel' petroglyphs serve as a nice illustration of this connection. Joint research experience of scientists and reindeer herders in Chukotka is very important for cooperation of research on arctic populations of wild reindeer in Taimyr, Yakutia, Chukotka and northern America.

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Wild forest reindeer as a resource in western, central and southern Yakutia

Состояние ресурсов лесного дикого северного оленя в западной, центральной и южной Якутии

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Abstract: There are three macro populations of forest reindeer in the taiga part of Yakutia. They are the western Yakutian population located to the west of the River Lena; the southern Yakutian population located to the east of the River Lena and restricted by Aldan in the north and the mountain ranges Dzhugdzhur, Sette-Daban and Skalistyi in the north-east; the third population is located in the north-east of Yakutia.

In 2001, Biological Resources Department of Nature Protection Ministry of Sakha Republic (Yakutia) counted reindeer from the air. According to this data, there were about 6500 reindeer in the western Yakutian population, including 4500 reindeer in Leno-Olenekskoe interfluve. The same territory had 7200 reindeer according to the air count carried out in 1963-1965 (Tavrovskii *et al*., 1971). The average density of reindeer population of 0.40 animals per 10 km^2 in 1963 to 1965 is two times higher than the 2001-count which had 0.22 animals per 10 km^2. There were about 2000 reindeer in Leno-Viliuiskoe interfluve in 2001, with the average density of 0.25 animals per 10 km^2. There were 5300 reindeer on the territory of the interfluve in the 1960s, the average density of population being 0.65 animals per 10 km^2. This means that the population decreased more than 2.5 times since then. The southern Yakutian population had 8000 reindeer according to the air count of 2001. Altogether, there are 12 500 reindeer in western, central and southern Yakutia.

According to Egorov (1965), the total population of forest reindeer in Yakutia made up 100-120 thousand in the 1960s. Today the size of the population is very low. In our opinion, one of the main reasons for the decreasing reindeer populations in western, central and southern Yakutia is the reduction of lichen grounds caused by forest fires. Succession goes very slowly on burnt grounds in the northern taiga and conditions require several decades for full recovery of lichen. Another significant factor is predatory activity of wolves whose number increased considerably over the 1990s. Wild forest reindeer in the north-east and south of Yakutia also compete hard with domestic reindeer in their access to pastures. It is common for herders to be intolerant towards wild reindeer; herders try to kill them in areas where they herd domestic reindeer.

The prospects for the future are quite uncertain. Southern and western Yakutia ranges of reindeer are among zones planned for intensive industrial development which will put the breeding, calving and rut sites of wild forest reindeer under a serious threat.

Forest reindeer as a resource are used little in Yakutia today, which has to do with their low number, high level of mobility and difficulties in hunting this very vigilant animal. According to their data, the concern 'Sakhabult' hunted 11 093 reindeer (of 18 984 licenses issued) in Yakutia in 2002, including 140 forest reindeer. In 2003 they hunted 9053 wild reindeer (15 059 licenses issued), including 182 forest reindeer. The share of forest reindeer in the total number of hunted animals is very small. According to Safronov *et al*. (1999), forest reindeer make up 1 to 3% of all hunted reindeer in Yakutia.

We must admit that forest reindeer in Yakutia today do not constitute an important hunting resource. Due to their low and still decreasing number, we think that there are good reasons for a complete ban of hunting forest reindeer, at least in western, central and southern Yakutia.

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Number and density of red deer population in Yakutia

Численность и плотность населения благородного оленя в Якутии

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Abstract: The territory of the state reserve "Olekminskii" has the highest density of red deer in southern Yakutia. According to the results of the winter routes count (WRC), carried out by the research department of the reserve, the density of red deer was 1.0 to 1.5 animals per 10 km^2 in 1987 and 1.3 animals per 10 km^2 in 1990. According to WRC, the density of red deer varied from 0.6 to 1.9 animals per 10 km^2 during the period from 1997 to 2006 at the northern border of the population's habitat in central Yakutia, on the territory of the national nature park "Lenskie stolby". The highest density was registered in the valley of the River Zhil'chur (the right tributary of the Lena River) and made up 5.4 animals per 10 km^2. The lowest density was observed in the valley of the Lena River near the park "Lenskie stolby" and in the valley of the River Labyia (the right tributary of the Lena River) and made up 0.5 animals per 10 km^2. No traces of red deer were registered in the valley of the River Echite (the right tributary of the Lena River). The density of the population was 1.3 to 1.5 animals per 10 km^2 in the valley of the River Buotama. For the past ten years, the average density of red deer was 1.0 animal per 10 km^2 on the territory of the national nature park.

According to the air count carried out by the Biological Resources Department of Nature Protection, Ministry of Sakha Republic (Yakutia) in 1999 and 2001, the density of red deer in Yakutia varied from 0.10 to 0.54 animals per 10 km^2 and the average density of the population in the republic was 0.14 animals per 10 km^2.

In summer time, deer concentrate in solonetz (natrium-rich soil) areas and hence their density in this period is always above the average. According to researchers from the reserve "Olekminskii", the density of red deer near solonetz areas was 5.0 animals per 10 km^2 in 1999. According to our observations, the same parameter reached 3.0 animals per 10 km^2 near solonetz areas on the River Turannakh (the right tributary of the River Buotama), which is high for central Yakutia.

We also carried out deer counts during rut time when we counted roaring animals. The density of roaring and not roaring deer that we met in the national nature park "Lenskie stolby" was uneven, with the highest number of red deer registered in the valley of the River Buotama and its tributaries. According to the survey data, the biggest number of female deer in a 'harem' reached 9 animals in the valley of the River Olekma, 8 animals in the valley of the River Tokko and 5 animals in the valley of the River Buotama. Researchers from the reserve "Olekminskii" registered 5.0 to 7.0 animals per 10 km^2 during rut time in the valleys of the River Olekma's tributaries, Rivers Bol'shaia Dzhikimdia, Malaia Dzhikimdia and Taryn. We registered 12 animals (3 males and 9 females) in the mouth of the River Buotama in the area of 5 km^2.

In winter time, red deer concentrate in river valleys. According to WRC, the density of red deer reached 7.0-10.0 animals per 10 km^2 in those places in the valley of the River Buotama where its high-water bed is the widest and thus has the best browsing conditions. According to WRC done in the reserve "Olekminskii", the density of red deer reached 11.4 animals per 10 km^2 in the valleys of the Rivers Bol'shaia Dzhikimdia and Malaia Dzhikimdia.

In spring with its thaws and snow crust, the density of red deer is also high in river valleys. However, animals concentrate on hill slopes instead of high-water beds and prefer southern sides where the first thawed patches and greenery appear. We registered 8 animals on a 10 kilometers route in petrophyte steppes of the River Buotama valley.

Summing up, we suggest that the density of red deer varies from 0.03 to 10.0 animals per 10 km^2 in some places in Yakutia today. Extrapolation of this data to the whole habitat of red deer in Yakutia brings the total density to 0.4 animals per 10 km^2. As the habitat of red deer increased nearly twice, going from 60 000 to 120 000 km^2, we may calculate that the number of Yakutian red deer reached approximately 4800 animals. This means that the number of red deer increased by 35% over the past fifty years.

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Conservation of mammals in the Ural

Охрана млекопитающих на Урале

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Abstract: Well-grounded protection of animals requires conducting systematic scientific research and monitoring of the animal world, carrying out complex and targeted scientific and technical programs and projects at oblast, regional, federal and international levels. Protection measures towards any species must be grounded in scientific research and evaluation. The same applies to developing legislation that regulates human activity in relation to the animal world. Any nature protection activity should have scientific and legislative basis which is taken into account when working out measures on animals' protection. Below we provide a brief overview of each of the existing measures.

Regulation of animals' use is one of the oldest methods of their protection that was applied already in a primitive society.

We distinguish two sub-methods within it:

a) total ban on hunting at regional and federal levels (e.g., beaver, sable and polar bear hunting) with subsequent inclusion of a species into the Red Book;
b) introduction of hunting norms (quantitative, territorial, seasonal) that imply rational hunting of a certain part of species' population.

Rational hunting is a protection method because unhunted populations change their structure significantly. Thus, the population's degradation and share of aged animals increases while reproduction and population dynamics go down.

Preservation and improvement of animals' habitats, also known as biotechnical measures, are among most common animals' protection methods, especially in hunting. These measures are necessary when most valuable parts of animals' habitats are destroyed as a result of their irrational use. These measures include planting forage and protecting plants, building nesting places, creating reservoirs (with drinking water, e.g.), solonetz and foraging places and flutter grounds.

In order to protect large territories with many different species, a network of protected nature territories has been created. It includes territories with different status and purpose, such as national parks, reserves, reservations and natural monuments, which preserve not just one or several species but also their whole communities and complexes of the most valuable habitats.

Measures such as keeping and breeding animals in captivity or partial captivity are aimed at preservation of the rarest and on the verge of extinction species. Such measures have been applied to preserve bisons, sable and spotted deer.

Introduction or translocation is another method of preserving population of some species. It involves artificial translocation of animals to empty territories. In Russia, large scale introduction measures have been taken to preserve such species as musk-rat, sable, raccoon dog, beaver, squirrel, wild boars, red and spotted deer and others.

Animals' and nature protection are impossible without building an ecological way of thinking within the society. To achieve this, various educational activities are carried out among schoolchildren, students and experts who work with nature. Mass media, parties, social movements and organizations are also involved in popularization of nature protection. The Red Books have recently been published frequently.

There is no centralized biota monitoring service in the Urals today. The dynamics of rare and endangered animal species populations reflects changes in biological diversity of the fauna and thus provides indirect information about the animal world in the Urals in general.

For the last 2-300 years, flora and fauna in the Urals have been under increasing anthropogenic pressure, initially due to cutting down of forests, mining and agricultural development, and later due to industrial and transport development, chemicalization of agriculture, melioration, urbanization and recreation.

Ecosystems' integrity is based on functional interrelations within a certain complex of species that is the result of a long evolutionary process. Loss of a single element within a system can have negative consequences, such as irreversible decrease of ecosystems' reproduction and resistance to anthropogenic pressure. That is why much attention has been paid recently to preservation of nature biodiversity. This problem is of a supreme applied importance and is closely related to protection of biological resources, of which mammals are an integral part.

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Consequences of two reindeer herding strategies in northern Mongolia

Результаты двух стратегий выпаса северных оленей в Северной Монголии

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Abstract: The Tsataan are a community of reindeer herders that have been politically and geographically isolated in the taiga and alpine tundra areas of Hovsgol Province in northern Mongolia. They are divided into two geographically isolated groups; a Western Taiga (WT) population, practicing a nomadic lifestyle that is relatively consistent with historical trends, and which is divided into subgroups of between 2-8 families that herd 20 to 250 reindeer per group. WT herders tend to move every 5-6 weeks from high elevation grazing areas in summer to camps below tree line in winter. The Eastern Taiga (ET) population is subdivided into larger groups of 10 to 15 families per group, herd fewer reindeer and are more sedentary, moving only four to six times per year. ET herders will often graze their animals in lower elevations near villages or in areas that are more easily accessible to tourists. The two distinct populations present an opportunity to compare two dichotomous management strategies and the consequences of their decisions on the productivity of their respective reindeer herds. Evaluation of grazing areas and nutritional status of reindeer among the two populations were conducted in August 2006.

More distinct species of forage plants were found in the ET grazing area. Crude protein (CP) concentrations and digestibilities of forage plants tended to be higher in the ET camp but were likely related to differences in phenology. Sodium concentrations were very low in all forage except for mushrooms.

There were no significant differences in jaw and tail length of all sex and age classes of reindeer in ET and WT camps, but girth (132.2 ± 2.8 cm) was significantly less ($P \leq 0.05$) in females of a WT camp. Body length of adult females was significantly greater ($P \leq 0.05$) in ET camps (168.3 ± 2.6; 165.7 ± 2.4 cm) than in WT camps (161.6 ± 1.5; 161.5 ± 1.1 cm) while shoulder height was significantly greater in ET (119.1 ± 1.5 cm) than in WT adult steers (112.2 ± 1.1cm). BCS were significantly higher ($P \leq 0.01$) in ET adult females and male calves (2.4 ± 0.1; 2.4 ± 0.1) than in adult females and male calves of WT camps (1.0 ± 0.0; 1.3 ± 0.3). Milk yield was significantly higher ($P \leq 0.001$) in ET females (243.1 ± 14.5 ml/animal^{-1}) than in WT females (140.2 ± 22.4 ml/animal^{-1}).

Reindeer from the ET camps were in better body condition, had higher milk yields and may have experienced better long term nutrition than reindeer from the WT camps. Although stocking density and the quality of grazing areas may be responsible for these differences, animal use patterns such as intensive use of males for transportation, intensive and prolonged milking practices and early weaning of calves may have influenced the energy balance of reindeer under the different management strategies.

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Exceptional fur insulation in Siberian musk deer

Мех сибирского мускусного оленя как уникальный изолятор

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Abstract: Musk deer (*Moschus moschiferus*) are small (7-17 kg) solitary forest ruminants which occur throughout east and south-eastern Asia from Himalaya to Siberia, where they may be exposed to the lowest ambient temperatures in the northern hemisphere. Such animals, with their small mass, large surface area and long legs are likely to be highly susceptible to cold.

We had the rare opportunity to study five adult musk deer, originally captured in the Altai region, at the Chernogolovka Research Station of the (then) USSR Academy of Sciences outside Moscow, in November 1992. The body mass of the animals ranged between 9.9 and 12.1 kg, and were kept outdoors under natural light and temperature conditions.

Scanning electron microscopy revealed that the hairs of the musk deer fur are hollow and consist of a honeycomb of small air-filled cells enclosed by a thin cuticle. The individual hairs are wavy and densely packed, the fur having a density of 420 hairs·cm^{-2}. Fur depth, as measured at 31 sites on the trunk with a graded needle, ranged from 30 to 43 mm.

The conductance of the pelt was determined as described by Kvadsheim *et al*. (1994) in *J. therm. Biol.* 19: 431-435. The value obtained for the musk deer pelt was 1.27 W·m^{-2}K^{-1}.

A total of thirty-six measurements of resting metabolic rate (RMR) were made in all five animals by use of indirect calorimetry, and rectal temperature (T_{rec}) was measured in two of the animals at ambient temperatures from -26 °C to +13 °C. The RMR was stable at 3.39 ± 0.41 (SD) W· kg^{-1}, with a stable T_{rec} between 38.5 °C and 39.0 °C, throughout the range of ambient temperatures. The RMR was 50% above the expected value, which in part may be due to the fact that the animals were maintained on a rich diet and were not starved prior to the experiments.

In conclusion: The small musk deer have an amazing fur insulation, which is comparable with that of the ten times bigger arctic reindeer (*Rangifer tarandus*).

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Breeds of domestic northern reindeer of Yakutia

Породы домашних северных оленей Якутии

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Abstract: Through the simplest zootechnic techniques, reindeer herding peoples have contributed to the development of animals' specific features that would correspond to their way of life and climatic conditions. Pedigree stock of reindeer bred by people's selection has been validated and tested by scientists from Yakutsk Agricultural Research Institute and approved by Ministry of Agriculture of the USSR (order 212 from 23.08.1985).

Out of four breeds approved in Russia (Evenskaia, Evenkiiskaia, Chukotskaia and Nenetskaia), Sakha Republic (Yakutia) has three breeds: Evenskaia, Evenkiiskaia and Chukotskaia.

1) Evenskaia breed has a meat and transport type of constitution. It is bred in 12 uluses in mountain-taiga, tundra and forest-tundra zones of the republic (Tomponskii, Oimiakonskii, Momskii, Kobiaiskii, Bulunskii, Srednekolymskii, Ust'-Ianskii and other raions). The population of Evenskaia breed is 111 977 animals including 52 599 one- and two-year-old female reindeer. An average body weight is 135-145 kg for an adult male reindeer and 91-110 kg for a female reindeer. Slaughtering output is 48-50%.
2) Evenkiiskaia breed has a transport and meat type of constitution. It is bred in 9 uluses in taiga, tundra and forest-tundra zones of the republic (Gornyi, Anabarskii, Aldanskii, Mirninskii, Neriungrinskii, Olenekskii, Olekminskii, Ust'-Maiskii and other regions). The population of Evenkiiskaia breed is 38 499 animals including 16 519 one- and two-year-old female reindeer. An average body weight is 140-180 kg for an adult male reindeer and 108-130 kg for a female reindeer. Slaughtering output is 46-49%.
3) Chukotskaia breed (also known as 'khargin') has a meat-type constitution. It is bred in 2 uluses in the tundra zone (Allaikhovskii and Nizhnekolymskii raions). The population of Chukotskaia breed is 18 654 animals including 9373 one- and two-year-old female reindeer. An average body weight is 130-140 kg for an adult male reindeer and 93-96 kg for a female reindeer. Slaughtering output is 53-55%.

In the 1970s, stud bucks of the Tofalarskii type of reindeer of the Evenkiiskaia breed were introduced to Yakutia from Irkutskaia oblast in order to be crossed with Evenskaia breed. Reproductive crossing led to the creation of Tofalaro-Evenskaia and Chukotsko-Evenskaia crossbreeds in the Momskii, Tomponskii, Anabarskii and Bulunskii regions. Both breeds have high meat characteristics.

Through inter se breeding, reindeer state farms of Sakha Republic raised the number of their reindeer to 30-40 000 animals. Crossbred animals of 1.5-2.5 years old had 12-16 kg more body weight compared to their analogues. However, the highly productive crossbred reindeer were not preserved. The main reason for this was that the organization and implementation of breeding changed with the collapse of the state owned farms. As a result, population of domestic reindeer decreased all over. Also, herds of Tofalaro-Evenskaia and Chukotsko-Evenskaia crossbreeds were liquidated.

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On the morphology of *Cervus elaphus* L. (1758) of Yakutia

К морфологии cervus elaphus l. (1758) Якутии

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Abstract: The average body length of a Yakutian male and female red deer is 239.0 cm and 209.5 cm, respectively. Height at the shoulder is 152.0 cm and 126.0 cm, height at hips is 145.3 cm and 125.0 cm, chest girt is 172 cm and 134 cm accordingly. The weight of both male and female red deer is 340 kg.

Compared to a Yakutian red deer, a maral deer has lower height at the shoulder than at hips. In this respect, a Yakutian red deer is closer to a Manchurian deer that is higher at the shoulder and lower at hips. In terms of the body length, a Yakutian red deer is closer to a maral than Manchurian deer. A Yakutian red deer has the widest chest girt and biggest body length compared to other red deer. Yakutian red deer's chest depth is less than that of a maral. What makes Yakutian red deer's chest girt wider compared to a maral is its width.

A Yakutian red deer starts to grow its antlers in the middle of April. The earliest time when we encountered a red deer with soft antlers was on the 14th of May. By the beginning-middle of May soft antlers reach 10 cm in length and after that they grow fast. We registered the following parameters of soft antlers: antlers with two branches were 28 cm long; antlers with three branches were 31.0 cm long; with four branches 33.7 cm, and with five branches 54.5 cm long. We met an adult male red deer that had soft antlers with two branches and two young male red deer that had soft antlers with three branches in the beginning of June.

The latest time when we encountered a red deer with antlers was on the 28th of March. We found several shed antlers in the valley of the River Buotama. Zoologist Krivoshapkin found recently shed antlers in the basin of the River Liutenga (the left tributary of the Amga River) on the 4th of April. Before shedding their antlers, male deer usually trample around low trees and rub their antlers against them, stripping off bark and thus leaving some kind of "marks". We found such "marks" on trunks of spruce, willow and aspen in the first half of March in the valley of the River Buotama.

The following craniological features of a deer change with age:
a) distance between forehead apophyses increases from 40 to 63.3 mm;
b) apophyses' diameter increases from 35.5 to 52.1 mm;
c) apophyses' height decreases from 40.9 to 32.1 mm.

The location of antlers in relation to the skull also changes with age, which probably has to do with antlers increasing their weight. Thus, antlers of a young (2-3 years old) male deer are bent more backwards while the angle between forehead apophyses and the back of the head is 40 degrees. At the same time, antlers of an adult deer are more upright and the angle is about 90 degrees.

The length of the main trunk of Yakutian red deer's antlers is 62-103 cm; the length of a middle branch is 22-40 cm; antlers' spread is 51-76 cm; the rosette's circuit is 23-29 cm; antlers' weight is 3-7 kg.

According to our data, red deer's antlers differ from those of a maral deer and Manchurian deer in the following respects:
1) the length of a supraorbital appendix is close to that of a Manchurian deer and longer compared to that of a maral;
2) circuit of antlers' trunk is bigger compared to all other red deer species;
3) antlers' length is shorter compared to a maral and closer to that of a Manchurian deer;
4) the length of a middle branch is bigger than that of a maral and Manchurian deer;
5) antlers' spread is smaller;
6) the rosette's circuit is bigger compared to a maral and Manchurian deer.

We think that there is correlation between the mass of antlers' trunk and antlers' spread: the heavier and thicker is the trunk, the less is antlers' spread.

Many species are subject to geographic variability and especially in places where different habitats meet. Therefore, the development of transitional forms is common. In this case, a Yakutian red deer can be either a very large version of a Manchurian deer or a smaller version of a maral. The linear parameters of its body and skull are closer to those of a maral, whereas constitution of antlers and fur colour bring it closer to a Far Eastern Manchurian deer. We suggest that a Yakutian red deer is a result of geographical variability and has morphological features that are transitional between two neighbouring sub-species.

The question of Yakutian red deer taxonomy is still open. Our data can contribute towards systematization of this species.

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Metabolic plasticity in the Yakutian horse

Функциональная мобильность метаболизма якутской лошади

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Abstract: Yakutian horses live within the temperature range from +38 to -62 °C, which is possible due to adaptive abilities and changes that are part of a general phenomenon of seasonal adaptation. We have studied how ecological features of the Yakutian horse change within an annual cycle in different acclimatization regions of Siberia and Far East.

We observed a range of annual changes in the ultra-structure of hepatocytes. Mitochondria get more polymorphous in winter compared to summer, which indicates constraints in energy balance. Also, the number and amount of glycogen inclusions increases. Intensification of peroxidation is an obvious sign of stress caused by winter conditions. It makes lipofuscin granules increase in both size and number. However, this can also be a way of preventing a detrimental effect of lipoperoxides. The capacity of a cell's lysosomal apparatus increased throughout the observation period which covered summer, autumn and winter.

The share of polyolefinic fatty acids grew in winter. We registered a shift in the spectrum of blood serum's fatty acids, which indicates changes in cytoplasmic membrane conductance and intensification of processes that finally lead to the disintegration of oxidative phosphorylation and increase of thermogenesis.

The increasing share of polyolefinic fatty acids is potentially dangerous as it can lead to the intensification of free-radical processes. Our data speaks for the growth of an antioxidant status among horses in winter and consequently the suppression of detrimental peroxidation processes. Antioxidant buffer is low in spring time and this can cause lipid peroxidation among weakened horses. During this period, the animals need microelement and vitamin supplements, such as selenium and carotenoids.

Our study of erythron's acid and alkaline resistance and variability of erythrocyte populations in terms of the size, number and correlation of hematoglobulin types demonstrates deep seasonal restructuring in hemapoiesis.

Concentration dynamics of thyroid's free hormones is related to an increase of thermogenesis and its peripheral regulatory effect during transitional seasons, which is from autumn to winter and at the end of winter colds.

Horses' need for energy increases significantly when it is very cold. The required gross energy expenditure is on average 65Mcal (272J.) per one horse in the middle of winter. At the same time, Yakutian horses can increase their body mass even during winter time, if provided with unlimited, easily accessible and high quality forage.

An interesting fact is that a horse's blood serum contains peptides that have a hyperthermic effect. Unlike hibernating animals, horses preserve and synthesize this peptide in summer.

We have observed a high degree of plasticity of metabolic reactions at various structural and functional levels. This functional plasticity of the Yakutian horse's metabolism is possible due to a high variability of physiological and biochemical processes and regulatory systems that determine seasonal adaptation of the Yakutian horse to extreme Yakutian conditions and its successful acclimatization in the highly varied biological and geographical conditions of Siberia and Far East.

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Body temperature change in reindeer during an annual cycle

Изменение температуры тела у северного оленя в годовом жизненном цикле

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Abstract: We studied the dynamics of reindeer's body temperature in the wild during 11.3 months taking measurements every 120 minutes. We used DS 1922 L-F5 programmable thermographs which we implanted under reindeer's skin in the interscapular region. We analysed more than 20 000 body temperature measurements and more than 8000 air temperature measurements in reindeer's habitats.

We discovered that reindeer like many other mammals are subject to clearly evident seasonal changes of body temperatures. We registered the highest average daily body temperature of reindeer in summer months: 37.46±0.056 °C in July and 37.74±0.018 °C in August. The temperature went down in autumn-winter season: 37.46±0.023 °C in September, 36.43±0.037 °C in October and 36.2±0.045 °C in November. Reindeer's body temperature dropped to 35.96±0.047 °C in December and remained minimal in January and February. It began to increase in March and dropped again in April (35.45±0.076 °C). The temperature gradually increased in spring-summer period reaching its maximum in summer: 36.32±0.067 °C in May and 37.19±0.073 °C in June.

Reindeer's body temperature varied within narrow limits in the coldest winter period: from 33.6 to 37.5 °C in December, from 33.3 to 37.7 °C in January and from 34.0 to 37.1 °C in February, which is 3.9 °C, 4.4 °C and 3.1 °C of variation, respectively. This indicator varied most at the end of winter. The range of variability made up 11.6 °C in April (from 26.8 to 38.4 °C) with body temperature reaching its annual minimum. While body temperature increased in spring-summer period, its range of variability went down at the same time. It went from 30.7 to 41.1 °C in May, from 31.4 to 41.6 °C in June and from 34.1 to 41.0 °C in July, changing by 10.4 °C, 10.2 °C and 6.9 °C, respectively. We registered a positive correlation between the dynamics of reindeer's average daily body temperature and average daily air temperature within the annual cycle.

Reindeer have elaborate mechanisms of physical thermal protection that allow them to endure low air temperatures without significantly increasing their heat production. In winter, reindeer's metabolism and energy expenditure stabilize at a low level, which increases their survival under the conditions of reduced food supply and extremely low temperatures. In summer time, reindeer's metabolism processes intensify and energy balance optimizes. This is clear from the seasonal variability of reindeer's body temperatures that we demonstrated above. According to our data, the critical period for reindeer is the end of winter (April) when the organism's physical processes intensify, endogenous energy resources are used up and it is more difficult for animals to forage.

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Seasonal change in body temperature of the Yakutian horse in north-eastern Siberia

Сезонные изменения температуры тела у лошади в условиях холодного климата северо-востока Сибири

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Abstract: We observed clearly evident seasonal changes of metabolic rate of the Yakutian horse in the course of our research. As the level of the horse's metabolism declined in winter time, it was assumed that its body temperature was reduced as well. However, no direct measurements of body temperature of the Yakutian horse in different seasons of its annual cycle have been taken until recently.

We conducted prolonged observations of the Yakutian horse's body temperature using DS 1922 L-F5 thermographs which we implanted under the animals' skin in the interscapular region. We studied changes of the horse's body temperature during 11 months taking measurements every 120 minutes. The Yakutian horse that we observed was kept free-ranging, 50 km to the south from the city of Yakutsk. The temperature conditions during the observation period were typical for this area. We took the thermographs out after a year and digitilized the received data. We analysed 4000 measurements of body temperature and about 8000 measurements of environment temperature.

We registered the minimum annual body temperature of the Yakutian horse in the period from November to February (28.5-29.0 °C) and the maximum annual body temperature in February and July-August (38.5-38.0 °C). We observed the maximum average daily body temperature of the horse in July (35.75±0.05 °C). The temperature started to go down in August, reaching its minimum in December (31.85±0.50 °C) and went up again in January.

The diagram of the changes of the Yakutian horse's body temperature within 24 hours is close to a sinusoid. The seasonal feature of these changes consisted of the increase of a gradient between day and night body temperatures against the decrease of environment temperatures. This is similar to gradient changes that are found among foxes and racoon dogs. The dynamics of both monthly average body temperature and environment temperature is unidirectional. The body temperature of the Yakutian horse was 1.5-3.5 °C lower throughout the observation period compared to that of smaller animals.

Temperature changes of peripheral body parts of the Yakutian horses that live in the cold climate conditions can reach 8-10 °C. The body temperature of the horses also changes seasonally, increasing in the first half of the year and going down in the second half of the year. We observed apparent surface hypothermia among the Yakutian horses during cold winter time.

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Do the quality characteristics of meat change when fast growing red deer (*Cervus elaphus*) are selected for venison production?

Меняется ли при быстром росте качественная характеристика мяса благородного оленя (*Cervus elaphus*), отобранного для производства продукции из оленины?

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Abstract: The New Zealand deer industry aims to supply market demand for deer meat (venison) by killing deer in early spring, generally when animals are 9-11 months old. The seasonality of growth, with a winter depression of growth and intakes, makes this a challenging target to achieve. Hence, a major strategy is to calve as early as possible and to maximise growth rates in the first 7 months of life before first winter. Currently a small proportion of animals achieve slaughter weight pre-winter, providing opportunity to hold through winter (when feed is expensive) and slaughter at peak market demand when prices are highest. These animals also present the opportunity to slaughter prior to winter, before their metabolism undergoes major changes. The meat quality of animals killed prior to winter is unknown, but based on the changes in animal metabolism (*e.g.* protein turnover in muscle) during winter and spring it is possible that there are significant differences in meat quality. The purpose of this pilot study was to compare quality attributes in meat from fast growing young red deer stags killed prior to winter with that of slower growing young red deer stags killed in early summer.

Fourteen male red deer yearlings were selected from the same cohort for slaughter from the same deer farm at Wairuna (South Otago, New Zealand). Seven of these animals were fast growing and reached slaughter live weight (average of 95.4 kg for the group) in late June, while the second group of deer (n=7) did not reach slaughter live weight (average of 97.9 kg) until 5 months later, *e.g.* in early December. All animals were transported the day prior to slaughter by deer trailer (125 km, 1.5 hr), to the deer slaughter premises (Otago Venison, Mosgiel, NZ) where they were slaughtered according to standard protocol. At 1 day post slaughter, carcasses were split in two halves and the left side was plastic wrapped and then frozen at -20 °C. The frozen half carcasses were later cut into forequarter, midsection and hindquarter using a band saw. Frozen samples (*M. longissimus*, LD, on the bone) were transported frozen from AgResearch Invermay to Ruakura for meat quality analysis. Two sections from the frozen LD were sawed off, weighed and left to thaw over night at 10 °C. One sample (Day 1) was analysed directly, the second (3 weeks) was re-packaged after thawing and will be stored for 3 weeks at -1.5 °C before the same quality measurements are carried out. The samples (Day 1) were then cooked in vacuum bags in a water bath to an internal temperature of 75 °C. The following meat quality attributes were measured; water-holding capacity (thaw loss and cooking loss), meat pH and tenderness.

The fast growing animals tended to have lower cooking loss, lower meat pH values and slightly more tender meat at Day 1 compared to the slower growing deer. It should be noted that all values measured for tenderness indicated very tender meat. Currently a sensory analysis is carried out using two consumer tests to evaluate the meat from the two treatment groups.

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Carcass composition and quality characteristics of meat from young reindeer (*Rangifer tarandus tarandus*) bulls and steers

Состав и качественная характеристика мяса быка и кастрата молодого северного оленя (*Rangifer tarandus tarandus*)

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Abstract: The Alaskan reindeer industry has produced meat for subsistence and local use and has at times been an important export commodity (Stern *et al*., 1980). Currently, Alaskan reindeer herders manage for and slaughter adult steers (castrated males > 3 years old) (Alaska Agriculture Statistics, 1990-2006), a technique developed to improve meat quality and increase carcass yield during winter. The steers are expected to keep in a consistently improved nutritional status over the winter compared to bulls that might lose considerable body mass and muscle energy stores during the rutting season. Younger males may not be as affected by the rut so early castration might not affect yield and quality as suggested for adult males.

In this study, 13 reindeer (6 bulls and 7 steers; age 2 years) were included to evaluate the effects of ca-stration (at 13 months of age) and slaughter of younger animals on carcass yield and meat quality attributes. Carcass weights of the bulls (average 41.0 kg) tended to be slightly higher than for the steers (average 37.7 kg) (P=0.07), but there was no difference in dressing percentage between the groups. The weights of the commercially valuable hindquarter cuts; inside (*M. semimembranosus*), outside (*M. biceps femoris*) and sirloin tip (*M. quadriceps femoris*) were significantly higher for the bulls compared with the steers; inside (1.7 kg bulls and 1.5 kg steers, P=0.001), outside (1.1 kg bulls and 0.9 kg steers, P=0.02) and sirloin tip (1.3 kg bulls and 1.2 kg steers, P=0.01).However, comparing the proportions these three cuts represented of the whole carcasses for bulls and steers, no differences between the groups were found for any of the cuts. The meat quality attributes measured were very similar between the two groups. Meat ultimate pH values (measured in the striploin; *M. longissimus*) were all high (average 6.28 for bulls and 6.10 for steers) indicating low muscle glycogen stores at slaughter probably related to a animals in poor body condition being exposed to pre-slaughter herding stress. A trained sensory panel evaluated the meat samples on the attributes; smell intensity, tenderness, juiciness, gamey flavour, blood flavour, liver flavour and sweet flavour using a continuous line scale from 0 (low intensity) to 10 (high intensity).There was a tendency towards higher scores for blood flavour (P=0.06) and liver flavour (P=0.1) in meat from bulls compared with steers.

It was concluded that carcass yield and meat quality of 2 yr old reindeer bulls and steers were similar. However, it should be noted that the pH values measured in all the carcasses were high and can not be considered to represent meat of optimal quality. High pH meat (DFD or dark-cutting meat) is a well documented quality defect that affects meat tenderness, water-holding properties, colour and shelf-life.

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Developing reindeer pasture inventory - Pasture inventory in the reindeer districts in Middle-Lapland, Finland during 2005-2006

Развитие пастбищной инвентаризации – учет пастбищ в оленеводческих районах средней Лапландии, Финляндии за период 2005-2006 гг.

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Abstract: Reindeer pastures in the whole herding area in Finland were studied for the first time in 1995-1998 by using field work and remote sensing. Afterwards the inventory method has been developed in many ways and the pasture monitoring project has been concentrated in the northern part of the reindeer herding area in Finland. During 2004-2006 the inventory methods have also been developed. Permanent field sites are now located more comprehensively in each reindeer herding district taking into account the existing pasture rotation systems. Amounts of lichens, wavy hair grass, dwarf shrubs and other food plants are measured more accurate than before by using the "knot measuring method". Classifying the condition of lichen pastures has been modified describing the ecological state of lichen cover in more detail. Classification method of satellite images has been changed from supervised to the semi-unsupervised classification method and several steps of post-classification correcting have been added. Evaluating the distribution of infrastructure in each herding district has been integrated in the inventory.

During 2005-2006 the reindeer pastures of seven districts in Middle-Lapland were studied using the new methods. Highest amount of lichen was found in the Kemin-Sompio's and smallest amount in the Oraniemi's lichen pastures. Nearly in all districts, amount of lichens were higher in winter range than in summer range area. Amount of lichens in the Kemin-Sompio winter range area was 2.5 fold compared to summer range area and the state of lichen pastures was in the class, well recovering (lichen >1000 kg/ha). Nearly in all other districts, lichen pastures in winter range areas (except Pohjois-Salla and Kyrö) were in the class, heavily worn-out (lichen <300 kg/ha). Compared to the previous inventory (1995) condition of lichen pastures was the same in Muonio, Sattasniemi and Pohjois-Salla but had deteriorated in all other districts. Proportion of lichen and arboreal lichen pastures was highest in the Muonio and lowest in the Oraniemi district, but for the proportion of dwarf shrubs-, leaf- and grass pastures the situation was opposite. Outside the national parks and conservation areas, large scale changes in forest and landscape structure caused by forest industry were detectable in the detailed pasture maps. Observed changes in the proportion of pasture types between the two inventories were caused by actual changes in pastures but also by changes in the classification methods. Due to forest industry the amount of arboreal lichen pastures has decreased, while the amount of dwarf shrubs-, leaf- and grass pastures has increased in most of the districts. Different forms of land use (forest industry not included) covered 0.5 to 2.6% and their disturbance areas covered 3.4 to 25.5% of the total area in the districts, respectively.

Importance of reindeer grazing for the deterioration of lichen pastures is obvious but there are also several other utilisation pressures on pastures due to other forms of land use. Differences between seasonal range areas show that to keep lichen pastures in good condition a well-working pasture rotation system is required, where the winter range is continuously grazed by a sustainable number of reindeer only in winter time. Outside the conservation areas, old growth forest areas have decreased and fragmented and replaced by felling and sapling stand areas and young cultivation forests. The expanding the area of infrastructure further stresses fragmentation of pastures, although infrastructure also helps reindeer husbandry.

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On the use of tundra ranges in Yakutia by domestic reindeer during the snow free period of the year

Использование тундровых пастбищ Якутии домашними северными оленями в бесснежное время года

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Abstract: We studied the behaviour of domestic reindeer in the lower reaches of the River Indigirka during a snow free period of the year. They have a particular type of reindeer there called "khargin". It was bred in Chukotka on pastures that are poor in lichens. Almost the whole territory of tundra pastures consists of very icy soils. Underground ice is sometimes located very close to the surface, at the depth of only 20-30 cm, which means that intensive grazing of such grounds can cause melting of underground ice.

Domestic reindeer usually graze around a chum (reindeer herders' mobile dwelling) and around a camp in winter time. In a snow free period of the year, reindeer herders drive reindeer to their pastures and back to the chum three times a day, which corresponds with the eating regime of the herders. Thus, a usual herding shift lasts 8 hours. Sometimes the shift can be 12 hours, in which case reindeer are driven to pastures and back twice a day.

In hot weather reindeer start running in circles trying to escape from insects. They stay very close to each other while running and sometimes make more than 30 km per day. They can do that for up to several days. This increases the burden on the pastures. The degree of overgrazing (trampling) caused by such running is 7 to 10 times more compared to pasturing in cool weather. More than that, reindeer almost do not forage during the running. In cool and cloudy weather when there are not so many gnats and bot flies, reindeer can forage comfortably and pastures are not destroyed by trampling.

A daily pasturing area per reindeer depends on the season. During a snow free period of the year, reindeer herders cover the distance of up to 200 km, the average being 177.4 km. During this time they make 20 to 30 stops and spend from 3-4 to 6-7 days in one place covering a distance of 6-7 km or even more.

The depth and density of snow is very important for successful reindeer breeding. We experimented with melting snow by covering its surface with loessial loam and lichen dust. As a result, the snow melted 20 days earlier than normally. Such artificial speeding-up of snow melting allows calves to be born on the warm lichen instead of cold snow, which increases their chances to survive as well as saves female reindeer from spending energy on getting food from under icy snow.

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An effective drug developed against necrobacillosis

Способы и средства высокоэффективной профилактики и борьбы с некробактериозом животных

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Abstract: The decrease of reindeer population is caused primarily by the significantly increased anthropogenic impact on the animals as well as by various diseases, particularly necrobacillosis (*Fusobacterium necrophorum*).

Necrobacillosis has been recorded among reindeer in all of their habitats. This disease causes serious economic damage to northern reindeer herding making up to 30% of total estimated damage. Reindeer's sickness and death rates are 2 to 3 times lower in coastal tundra compared to the continental zone. Most places where the situation related to necrobacillosis is problematic are located in the tundra zone where the share of diseased and dead animals is 51.2% and 54%, respectively. The forest zone has the lowest sickness rate. While all age and gender groups of reindeer are subject to necrobacillosis, the highest sickness rate is registered among adult reindeer (72%) and the highest death rate among reindeer calves.

Reindeer are most susceptible to necrobacillosis among all domestic animals and therefore suffer from this infection more than other types of animal husbandry. Thus, according to reports on infectious diseases among reindeer in 2005, there were registered 103 problematic places on the territory of arctic uluses, where 28 992 reindeer fell sick and 7034 out of them died. The serious situation of necrobacillosis among reindeer and the significant economic damage on reindeer husbandry and food industry have made it urgent to study the epizootic status in different reindeer habitats within the Russian Federation and to develop a scientifically based system of sanitary preventive and medical measures to effectively fight this disease. The system consists of applying an inactivated emulsified anti-necrobacillosis vaccine intradermally to reindeer. Each injection is 0.2 ml and is given once with the help of a needleless device of Russian production.

Application of this vaccine in Sakha Republic (Yakutia) reduced the sickness rate among reindeer from 5-7% in the period 1996 to 2000 to 2.2% in 2005. At the same time, the death rate decreased from 53.7% in 1996 to 17% in 2005. This indicates that the vaccine can be used not only as a preventive measure but also curatively. It prevents vaccinated animals from falling sick, reduces sickness rate and helps diseased reindeer get better. The vaccine has been registered in the Russian federation and is now widely used.

Therefore, necrobacillosis among reindeer can be treated successfully providing that diagnostic, medical and preventive measures are taken properly in due time.

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Results of ecological and immunological research of cattle in Viliui region of Yakutia

Итоги эколого-иммунологического исследования крупного рогатого скота вилюйской группы районов

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Abstract: We examined the following indicators of cattle's immunocompetent system (ICS): concentration of crude protein, immunoglobulin G, albumens, α- and β- globulins of blood serum, as well as indicators of phagocytic activity of peripheral blood neutrophiles.

Cows in Niurbinskii and Verkhneviliuiskii regions are subject to immune deficiency more often (20-42%) than cows in Viliuiskii and Suntarskii raions (10-15%). We registered significant changes in the immunocompetent system of animals in Niurbinskii and Verkhneviliuiskii regions. These changes include decrease of immunoglobulins' concentration and of organism's general responsiveness (low level of circulating immune complex).

The immune system of animals in Suntarskii and Viliuiskii regions that have better ecological conditions is more responsive compared to the immune system of animals in Niurbinskii and Verkhneviliuiskii regions. This is supported by the fact that the latter have many animals with an activated humoral component (increased level of circulating immune complex and relatively high concentration of immunoglobulins). This condition of the immune system is typical for the early stages of changes of immunity indicators under the influence of unfavourable anthropogenic factors.

Within the populations, there are many animals whose immunity indicators are within the physiological range, which speaks for the animals' high adaptive abilities. This is supported by the fact that animals from Niurbinskii and Verkhneviliuiskii regions demonstrate increased phagocytic activity and phagocytic capacity while a humoral component of the circulating immune complex is clearly depressed. The phagocytic system, being older than others, is less subject to immunotropic factors and seems to fulfil the functions of an organism's damaged element among animals from ecologically unfavourable territories.

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Intestinal microbiocenosis of domestic and wild ungulates of Yakutia

Кишечный микробиоценоз домашних и диких копытных животных Якутии

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Abstract: We have studied intestinal microbiocoenosis of domestic animals including cattle, herd kept horses, pigs, reindeer and bisons. We discovered that lactose positive *Escherichia*, spore-forming bacteria and *Enterococcus* spp. prevail in intestinal biocoenosis of clinically healthy new born animals during the first day of their life. At the same time, the content of representatives of normal flora, such as *Bifidus* spp. and other lactic acid *Bacillus*, is low. Intestines of new born animals contain spore-forming aerobic bacteria from the first days of an animal's life. Our data suggest that aerobic spore-forming bacteria are representatives of intestinal biocoenosis and serve to protect an organism from pathogenic and opportunistically pathogenic microorganisms, particularly during the first days of an animal's life.

Spore-forming aerobic bacteria of *Bacillus* type are quantitatively dominant representatives of normal intestinal microflora of animals living in the far north. Research on immunobiological responsiveness and intestinal microbiocoenosis of animals has revealed intestinal disbacteriosis among youngsters of cattle, pigs, reindeer and herd kept horses, as well as vaginal disbacteriosis among cows and decline of immune status of animals during long winter. Compared to other ungulates, bisons have qualitatively and quantitatively poorer intestinal microflora: we detected *Bifidus* spp., *Escherichia* spp., spore-forming bacteria, *Enterococcus* spp., *Proteus* spp. but no lactic acid *Bacillus*.

In contrast to domestic animals, wild animals such as moose and roe deer have *Bifidus* spp., lactic acid bacillus and spore-forming aerobic bacteria of *Bacillus* type. Roe deer also have a small quantity of *Enterococcus* spp. It is worth noting that spore-forming aerobic bacteria of *Bacillus* type are present in wild animals' intestines not in a cryptogamic but in an active vegetative state.

In sum, we have discovered, for the first time in cryolite zone conditions, that intestinal microflora of domestic and wild animals differs significantly. This fact is of high interest and requires further investigation.

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Content of mineral substances, including heavy metals, in blood of Yakutian horses

Содержание минеральных веществ, в том числе тяжелых металлов, в цельной крови якутской лошади

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We examined the content of inorganic phosphorus and iron in blood of two intraspecies groups of Yakutian horses that live in different nature and climate zones of Yakutia. We collected data in different seasons of the year. In winter time, phosphorus content is highest among horses of an indigenous type from Niurbinskii region (3.53±0.23 μmol/L), which is two times higher than among horses of Ust'-Aldanskii region and larger horses of Khangalasskii region (1.67±0.15 and 1.69±0.03 μmol/L, respectively).

We observed a general tendency towards statistically reliable decrease of phosphorus content in blood of all groups of examined horses during spring time. We recorded seasonal changes in iron content in blood of horses of all groups and types: 20.75±1.08 in winter and 18.05±1.08 in spring in Niurbinskii region; 25.2±0.43 in winter and 14.66±0.47 in spring in Ust'-Aldanskii region; 18.05±0.98 in winter and 17.05±0.78 in spring in Khangalasskii region. The level of iron content in blood of horses of different intraspecies types goes down to different degrees during spring period.

Table. Concentration of microelements in blood of an indigenous type of Yakut horse in different regions, in μmol/L, n=50

Raion	Lead	Cadmium	Mercury	Iron	Zinc	Manganese	Copper
Niurbinskii	1.158 ±0.20	0.302 ±0.01**	0.250 ±0.02**	2256.0 ±2.80*	102.1 ±1.20*	33.5 ±0.78	10.85 ±0.17
Ust'-Aldanskii	1.689 ±0.10	0.075 ±0.02	0.748 ±0.09	103.02 ±11.5	68.38 ±0.90	45.14 ±0.89	14.8 ±0.20

Note: The difference is statistically significant in comparison with data from Ust'-Aldanskii region, *P<0.01, **P<0.05.

We found that the concentration of lead, cadmium, mercury, zinc, manganese, copper and iron in blood of horses of different types is within normal limits (see table). The concentrations of cadmium, iron and zinc in blood of horses from Niurbinskii region are statistically higher compared to horses from Ust'-Aldanskii region: 4 times more cadmium, 1.2 times more iron and 1.5 more zinc. Our data supports a hypothesis about synergetic nature of relations between zinc and cadmium according to which cadmium holds zinc in organism's blood and tissues.

The excess of heavy metals' concentration in blood of horses from Ust'-Aldanskii region as compared to Niurbinskii region is 1.5 times for lead, 3 times for mercury, 1.3 times for manganese and 1.4 times for copper. This is due to differences in geochemical composition of soil and water, as well as to different concentrations of these elements in pasture between the regions.

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Presence of alphaherpesvirus in semi-domesticated reindeer in Finnmark county, Norway – Serosurvey and evidence of alphaherpesvirus infection by polymerase chain reaction

Наличие альфа-герпесного вируса у полуодомашненных северных оленей финского округа, Норвегия – серозное исследование и выявление альфа-герпесной вирусной инфекции через реакцию полимеразной цепи

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Abstract: Finnmark county in northern Norway is the biggest reindeer herding area in Norway with a total area of 56 682 km² and a total of 168 599 animals in 2004/2005. Reindeer mortality rates in Finnmark are estimated to be as high as 9% in adults and 15% in marked calves (2004/ 2005) or 36% in the total number of born calves (marked or not). Predators account for ap-proximately 85% of the losses. Persistent viral infections, such as alphaherpesvirus (CeHV-2) are believed to exist in Finnmark[1,2], and might partially explain up to 10% of the mortality. These infections could have an impact on reproduction (abortion) and calf survival causing relevant economical losses.

The present work was aimed at identifying the seroprevalence of alphaherpesvirus in reindeer in Finnmark as well to attempt to isolate a Norwegian strain of the alphaherpesvirus for se-quencing and phylogenetic studies. To assess the present alphaherpesvirus serological status in reindeer in Finnmark a large screening was designed using a Bovine gB-blocking ELISA kit tested to be functional in reindeer given the cross reactivity between animal species, and the homology between the glycoprotein B of the bovine and reindeer herpesvirus[3].

3300 animals were sampled from 2003 to 2006 at slaughterhouses in Karasjok, Kautokeino, Varangerbotn and Šuoššjávri as well as from live animals in the reindeer herding districts 16C and 16A. Sera, obtained from these 3300 animals, were tested. A total of 450 samples from the trigeminal ganglion of the fifth cranial nerve were collected and DNA was extracted. Specific primers (CR13 and CR14) for the detection of Reindeer alphaherpesvirus (RanHV-2) were used for amplification by PCR[4]. The PCR amplicons from some of the individuals were sequenced.

An overall seroprevalence of 49% was found in this serosurvey with very similar results between eastern and western Finnmark even though between districts seroprevalences varied from 8% to 91%. Regarding gender, a seroprevalence of 47% was found in males and 54% in females but this difference was statistically non-significant. Age was found to be statistically correlated with seroprevalence, calves having a much lower seroprevalence (7%) than adults (80%). Weight, time of sampling and district animal density data was also statistically analyzed.

Results indicate the presence of alphaherpesvirus DNA in the trigeminal ganglion. 350 bp amplicons were identified in several samples. Some samples were sequenced and compared with sequences on the Gene bank. Amplicons sequences were found to be identical with cervid herpesvirus 2 glyco-protein C gene (Accession no. DQ333391) and rangiferine herpesvirus 1, glycoprotein C gene, partial cds (Accession no. AF139909) for a sequence of 162 nucleotides. Though it's clear that the virus is present in the tested animals it remains unknown if this virus represents a new strain in reindeer.

Further studies within this project will attempt the isolation and characterization of the alphaherpesvirus present in the sampled reindeer as well as study the mechanism of infection and vertical transmission via an experimental infection. The chance of cross infections between reindeer and Norwegian IBR free cattle remains a situation to be evaluated.

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Importance of selenium microelement for agricultural animals

Значение микроэлемента селена для сельскохозяйственных животных

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Abstract: The territory of Yakutia is very diverse in terms of natural and geographical features. In some of its parts, the content of macro- and microelements and their ratio in plants does not always meet the task of providing normal metabolism in animals. We have distinguished various biogeochemical provinces and landscapes on the territory of Central Yakutia which differ in the content of macro- and microelements in their forage plants. We have occasionally registered mass delivery of unviable offspring, the so called "ton n'i-rei", in households of Amginskii ulus in Sakha Republic (Yakutia).

It has been suggested that the main reason for delivery of unviable calves in Amginskii ulus is the lack of vitamins, microelements and carotene in forage plants there. Although the idea may be basically true, it is still superficial. It is in fact the lack of selenium microelement that causes such damages of an organism. The valley of the River Amga is a geochemical province characterised by the lack of selenium in its soil and consequently also in plants.

The use of sodium selenite for treating incalvers and newborn calves in several uluses of Central Yakutia, including Amginskii, Churapchinskii and Tattinskii uluses since 2002 has achieved highly positive results. While 152 calves with this pathology were born in Amginskii ulus in 2002, there were only 8 such calves born in 2003 and none since 2004. The same parameter for Churapchinskii and Tattinskii uluses is 150, 28, 0 and 85, 23, 0, respectively.

We have shown that the active selenization of animals is a highly efficient preventive measure as we have not registered a single case of delivery of calves with this pathology since 2004.

Photos from the 12th AUC

The participants of the expedition to rural Yakutia on Amga river which included ample experience with Siberian roads, including observations of wolves, river boating, several welcoming committees, of which one has joined the group here, visit to a Yakutian horse breeding station, swimming in Amga river and a most enjoyable over-night stay with a Yakutian family at a remote homestead off Amga river. A trip never to be forgotten! Photo: B. Inga.

The participants of the expedition to a bison nursery at the mouth of Buotama river; Brad Griffith, US and Don Russell, Canada with guide, interpreter and local Yakutians. Photo: B. Griffith.

The herd of bisons that were transferred from Canada to the bison nursery on Buotama river in Yakutia in 2006. Photo: B. Griffith.

View of a small part of the pastures at a horse breeding station in rural Yakutia, where hordes of horses are bred and milked to provide the Yakutians with their favourite drink, sour horsemilk, during the summer, while this unique Yakutian horse roam wild during the grisly cold Yakutian winter. Photo: A.S. Blix.

A line up of horses during a milking session. These horses develop huge udders, and even (some of) the visiting reindeer experts were able to get milk from them! Photo: B. Inga.

The rural Yakutian homestead where the participants of the Amga river expedition spent a night with the locals and enjoyed a dinner loaded with traditional Yakutian dishes and drink (horsemilk etc.) and a series of song performances in each and every one of the six languages represented, so at the end we all felt like Yakutians. Photo: A.S. Blix.

A grand view of the Amga river region from the holy mountain. Photo: R.E. Haugerud

View of the banquet at the close of the conference at a rare moment when nobody gave a speech or a song, showing a tableful of Yakutian hospitability. And everybody agreed that it had been a conference to remember forever. Photo: B. Inga.

INFORMATION FOR CONTRIBUTORS TO **Rangifer** (2009)

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- The reference chapter shall be listed alphabetically according to the author: **Holleman, D. F., Luick, J. R. & White, R. G.** 1979. Lichen estimates for reindeer and caribou during winter. – *J. Wildl. Manage.* 43 (1): 192-201. (43 volume number, (1) number in volume series (can be omitted) and: 192-201 page numbers). You can also provide full journal names (NB: – dash before the journal name).
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Typing

- Use body text in 12 point size and double spacing with 4 cm margins on both left and right sides. Do not hyphenate at the right margin.
- Italics shall be typed. Taxonomic names in Latin (genus and species; e.g. *Rangifer tarandus tarandus*), book titles and journal names shall be written in italics.
- Submit manuscript in email attachment (use ordinary programs and versions) and forward also one good quality hardcopy. When accepted, the author submits the final manuscript as email attachment.

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- These shall be numbered with Arabic numbers (1, 2, 3 etc.) and accompanied by a short text, so they can be understood independently of the article text. Indicate in the manuscript where tables and illustrations will be placed in the text. The illustrations must be ready for printing and each figure must be submitted in a separate file. Save figures as ai-files (Adobe Illustrator), eps-files (Encapsulated PostScript). Graphs should be made from Adobe Illustrator, Power Point or Excel. Tables should be made from Excel.

Rangifer

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