

Same genes allow humans and domestic animals to survive in Arctic conditions

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Credit: Juha Kantanen, Luke

Juha Kantanen, a research professor at the Natural Resources Institute Finland (Luke), has collected a large set of biological materials and data for the study of the genomes of Northern domestic animals, reindeer, cattle and horses during his expeditions in a project called Arctic Ark.

"Adaptation and the close relationship between humans and animals are especially pronounced in the Arctic conditions. The animals, which have adapted relatively fast, also assisted humans in adapting to the conditions," Kantanen says.

The Arctic Ark researchers collected samples from domestic animals in Lapland, Arkhangelsk and Yakutia. In addition to reindeer, other domestic animals are kept and bred in the research areas. Kantanen's research team attended slaughtering during the coldest winter months in Yakutia to collect research materials for studies of gene functions in different tissues in extreme cold.

"Our results show that partially the same genes have been under natural selection in the Arctic conditions in reindeer, horses, cattle and even humans. These genes involve the ability to withstand cold, metabolism and immunity. We refer to this as convergent evolution or similar evolution of different species," Kantanen explains.

Independent animals that can survive on little resources are the goal

Florian Stammer, a research professor at the University of Lapland's Arctic Centre, has been leading the anthropological studies of the Arctic Ark. The researchers lived with the local people and participated in their [animal husbandry](#) to determine which characteristics are valued in animals in the Arctic region.

"People in the north value the same characteristics in all domestic animals: independence, ease of care and the animals being able to survive on a meagre diet. The animals behave well in a herd, are able to find their own pastureland and know how to return back home."

According to Stammer, domestic animals are bred by means of negative selection in Arctic communities. Individual animals are not picked based on the desired characteristics: instead, unsuited animals are eliminated from the herd. The significance of genetic diversity is also understood in Yakutia, and it is ensured.

"Neighbours often switch animals, animals from specific areas are highly valued and people want bulls from these areas, for example. In many cases, animals from as far away as possible are obtained for the herd. These are very deliberate and systematic strategies," Stammler describes.

Stammler emphasises the fact that native breeds and their breeding strategies have much to offer to agriculture. Volume is not the key in Arctic local communities. Instead, there is a sustainable attitude towards the input-output ratio.

"Native breeds are a living example of how useful diversity is. For example, Northern Finncattle produce much less milk than the commercial breeds, but consume less feed, require less medication and require less space in cowsheds. Many of the operating methods from our research areas could be utilised in the development of sustainable agriculture in Finland."

Humans and their partners

Artist Anu Osva attended the research trips to Yakutia and depicts in her work the northernmost domestic animals in the world and the people who take care of them.

"The three small Yakutian villages close to the Verkhoyansk mountain region and the people and animals in these coldest areas of the world really touched me. The artistic works I did there involves the Arctic area, animals as human companions, genetics and adaptation in general," Osva says.

Anu Osva is a trained animal breeding scientist and a trained painter. She considers it important to show both of these professions in her artistic work.

"My world view is a combination of science and art: there is no mysticism involved."

The union of science and art led Osva to art & science. Finnish practitioners of the method have established the Finnish Bioart Society.

"The method itself is very old. Artists have sought the company of scientists throughout the times. Now, scientists and artists work more concretely together, often as teams," Osva explains.

Osva's paintings of the small but sturdy Yakutian cows are already well known. She travelled to Siberia for the first time in 2005. For the concluding seminar of the Arctic Ark, Osva brought large paintings where video images are reflected on top of them .

"It's a laborious working method, but oh so wonderful. I strive to depict how humans have travelled side by side with these animals for thousands of years, and how both win on this shared journey. Neither needs to be a slave," Osva says.

An exhibition called Co-Travellers can be viewed at Arktikum Science Centre in Rovaniemi from 14 December 2018 to 3 March 2019.

Price of adaptation

With the help of the most recent genomics research methods, Juha Kantanen has studied how the genome of the Arctic domestic animals has changed from the ice ages to our days.

The genome of cattle shows that during the latest ice ages, over the course of the past million years, the number of animals in the cattle population has dropped and their genetic diversity has decreased. The DNA of the current domestic cows shows signs of the history of their

extinct wild ancestor, the wild ox or aurochs. The ice ages – the most recent of which ended more than 10,000 years ago – can also be seen in the genome of the Yakutian horse.

"In addition, we observed that when humans started to domesticate these [animals](#), only part of the genetic diversity of the ancestral wild populations was retained. The genome further deteriorated in the 19th century when breeds were established and some characteristics were eliminated," Kantanen explains.

The genome of reindeer has not been as effectively deteriorated by humans, even in Siberia. Kantanen is satisfied with the unique reindeer genome data that was collected during the course of the Arctic Ark. In future, it can offer answers to many questions regarding the diversity of [domestic animals](#).

The research on the cattle genome will also be continued. Kantanen discovered that even though the Yakutian cattle have lived in isolation, they are, surprisingly, genetically more diverse than European cattle.

"We currently believe that they originate from the same cattle domestication centre in the Middle East as our European cattle, but the Asian cattle may be based on a larger founder population. It is also possible that humans crossbred Asian [cattle](#) with Asian wild ox when travelling to the north. We plan to continue studying these issues," Kantanen concludes.

Provided by Natural Resources Institute Finland

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