Arctic Ark – project investigates human-animal adaptations to the Arctic environment

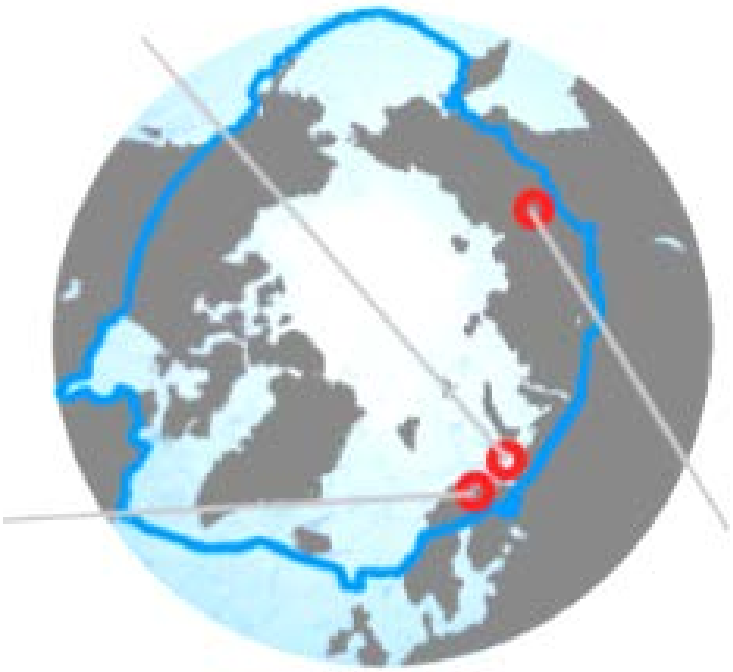
Juha Kantanen, Coordinator of the Arctic Ark – project and PI of genomics studies

Florian Stammler, PI of social-anthropological studies

In the Arctic, traditional animal husbandry is based almost exclusively on reindeer (*Rangifer tarandus*) but in Lapland, northern Russia and Siberia also other locally adapted animals, namely cattle (*Bos taurus*) and horse (*Equus caballus*) are used for food production and other societal and cultural needs.

Arkhangelsk

- Kholmogor cattle
- Mezen horse
- Nenets reindeer



Finnish Lappland

- Northern Finncattle
- Finnhorse
- Fennoscandian reindeer

Yakutia Eveno-Bytantaj

- Yakutian cattle
- Yakutian horse
- Evenki and Even reindeer


Reindeer has the longest adaptation history
(but the shortest domestication history) among the 3 species
and can be considered native to the Arctic.

PNAS

Tracking the origins of Yakutian horses and the genetic basis for their fast adaptation to subarctic environments

Pablo Librado[a,1], Clio Der Sarkissian[a,1], Luca Ermini[a], Mikkel Schubert[a], Hákon Jónsson[a], Anders Albrechtsen[b], Matteo Fumagalli[c], Melinda A. Yang[d], Cristina Gamba[a], Andaine Seguin-Orlando[a,e], Cecilie D. Mortensen[e], Bent Petersen[f], Cindi A. Hoover[g], Belen Lorente-Galdos[h,i], Artem Nedoluzhko[j], Eugenia Boulygina[j], Svetlana Tsygankova[j], Markus Neuditschko[k], Vidhya Jagannathan[l], Catherine Thèves[m], Ahmed H. Alfarhan[n], Saleh A. Alquraishi[n], Khaled A. S. Al-Rasheid[n], Thomas Sicheritz-Ponten[f], Ruslan Popov[o], Semyon Grigoriev[p], Anatoly N. Alekseev[p], Edward M. Rubin[g], Molly McCue[q], Stefan Rieder[k], Tosso Leeb[l], Alexei Tikhonov[r], Eric Crubézy[m], Montgomery Slatkin[d], Tomas Marques-Bonet[h,i], Rasmus Nielsen[s], Eske Willerslev[a], Juha Kantanen[t,u], Egor Prokhortchouk[j], and Ludovic Orlando[a,m,2]

[a]Centre for GeoGenetics, Natural History Museum of Denmark, University of Copenhagen, 1350K Copenhagen, Denmark; [b]Bioinformatics Centre, Department of Biology, University of Copenhagen, 2200N Copenhagen, Denmark; [c]UCL Genetics Institute, Department of Genetics, Evolution, and Environment, University College London, London WC1E 6BT, United Kingdom; [d]Department of Integrative Biology, University of California, Berkeley, CA 94720-3140; [e]National High-Throughput DNA Sequencing Centre, University of Copenhagen, 1353K Copenhagen, Denmark; [f]Center for Biological Sequence Analysis, Department of Systems Biology, Technical University of Denmark, 2800 Lyngby, Denmark; [g]Department of Energy Joint Genome Institute, Walnut Creek, CA 94598; [h]Universitat Pompeu Fabra/Consejo Superior de Investigaciones Científicas, 08003 Barcelona, Spain; [i]Centro Nacional de Análisis Genómico, 08028 Barcelona, Spain; [j]National Research Centre Kurchatov Institute, Moscow 123182, Russia; [k]Agroscope, Swiss National Stud Farm, 1580 Avenches, Switzerland; [l]Institute of Genetics, University of Bern, 3001 Bern, Switzerland; [m]Université de Toulouse, University Paul Sabatier, Laboratoire d'Anthropobiologie Moléculaire et d'Imagerie de Synthèse, CNRS UMR 5288, 31000 Toulouse, France; [n]Zoology Department, College of Science, King Saud University, Riyadh 11451, Saudi Arabia; [o]Yakutian Research Institute of Agriculture, 677002 Yakutsk, Sakha, Russia; [p]North-Eastern Federal University, 677000 Yakutsk, Russia; [q]College of Veterinary Medicine, University of Minnesota, St. Paul, MN 55108; [r]Zoological Institute of Russian Academy of Sciences, 199034 Saint-Petersburg, Russia; [s]Center for Theoretical Evolutionary Genomics, University of California, Berkeley, CA 94720; [t]Biotechnology and Food Research, Agrifood Research Finland, 31600 Jokioinen, Finland; and [u]Department of Biology, University of Eastern Finland, 70211 Kuopio, Finland

PNAS. 2015. 112(50): E6889-E6897

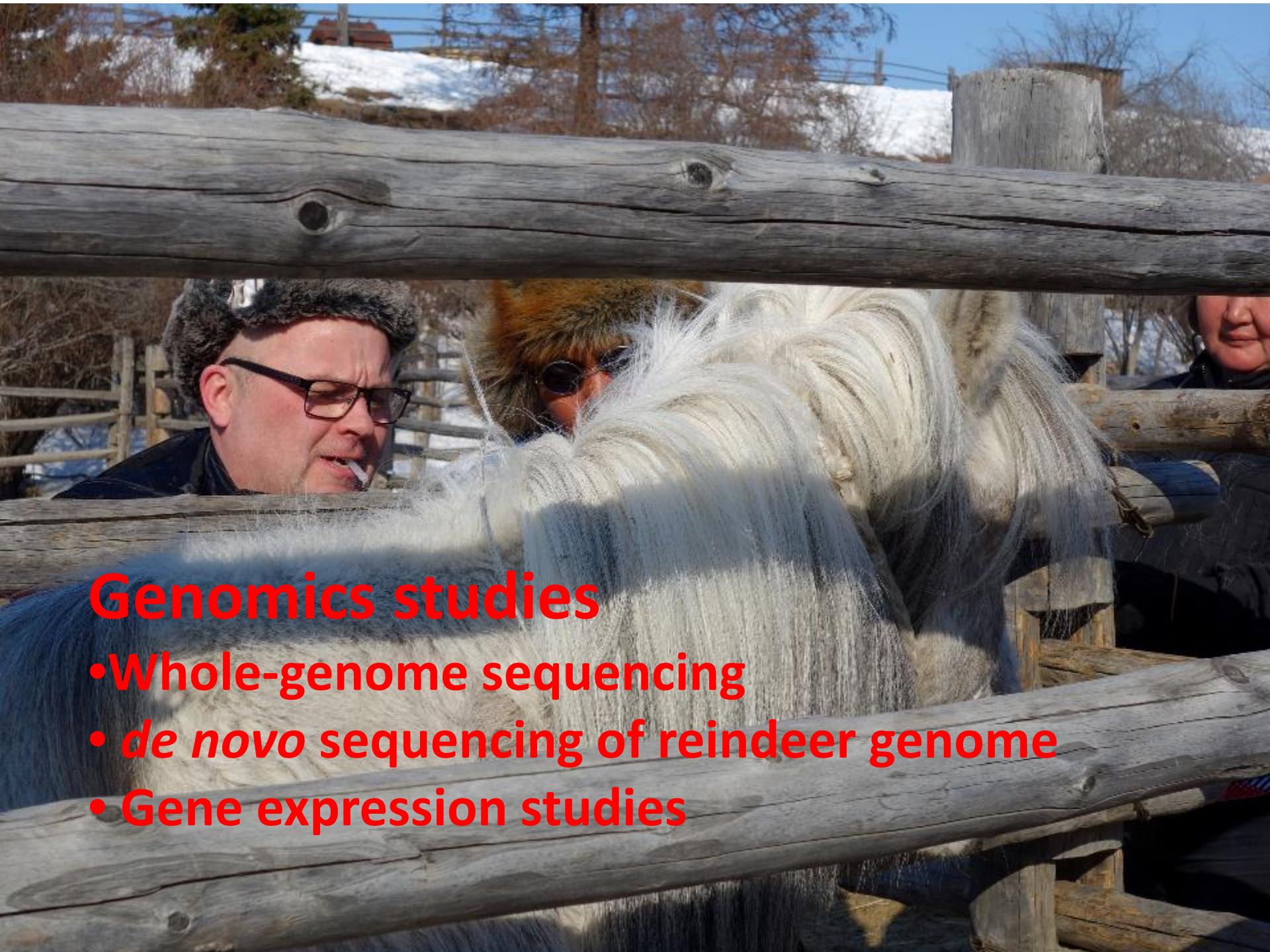
Interdisciplinarity for bold questions

See ArcArk poster ”interdisciplinary methods”

we contribute to the age-old debate to what extent humans and animals are determined by their genetic heritage and by their culturally characterized socialization

Our methods: interdisciplinarity is a challenge but also a big opportunity that promises completely new insights. See our methods poster:

Field work is done in collaboration



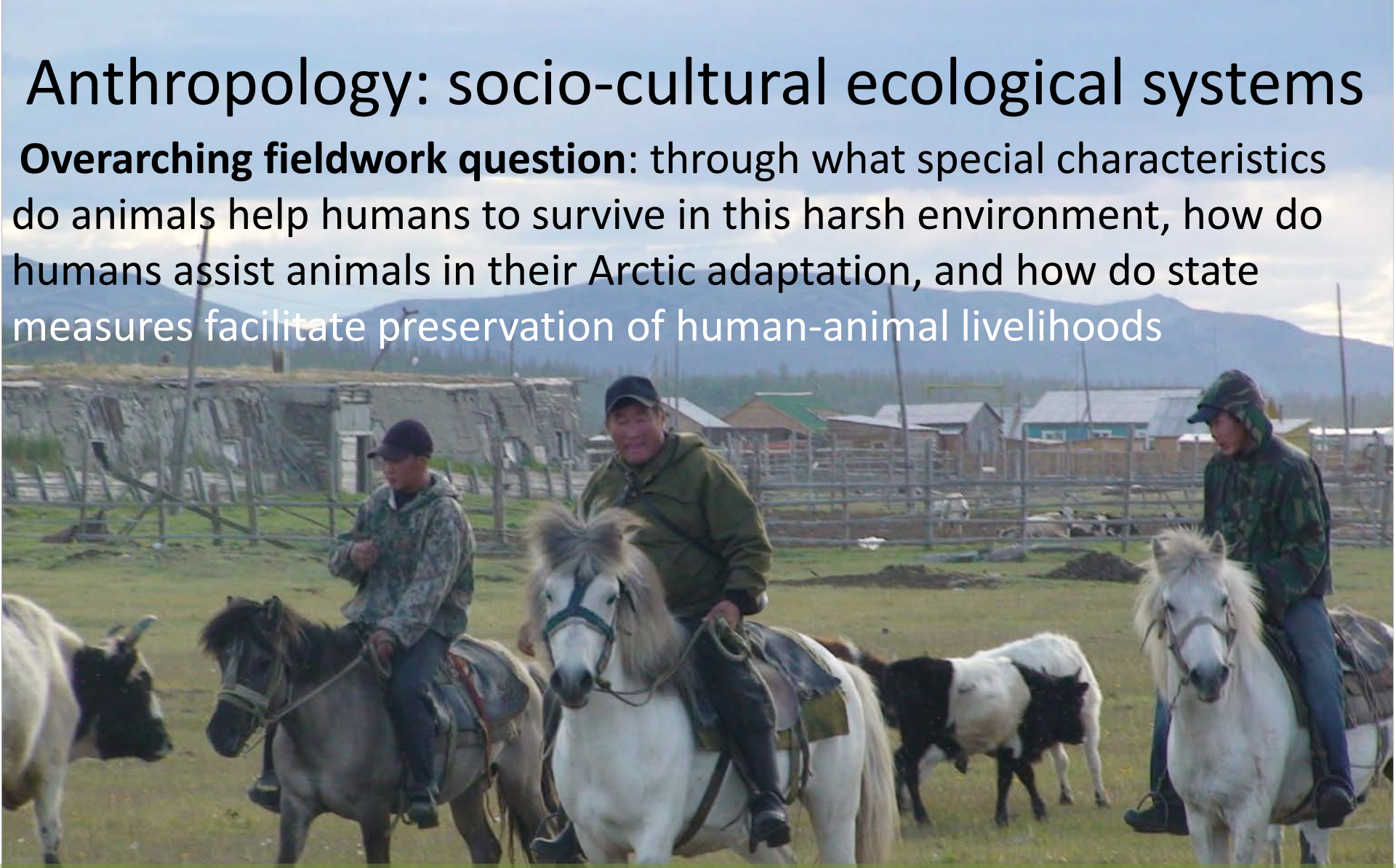
Genomics studies

- Whole-genome sequencing
- *de novo* sequencing of reindeer genome
- Gene expression studies


6 4 2016
LEH 2
Other omics studies
• Metagenomics
• Metabolomics
LEH2_kuva1_2016-04-06

Anthropology: socio-cultural ecological systems

Overarching fieldwork question: through what special characteristics do animals help humans to survive in this harsh environment, how do humans assist animals in their Arctic adaptation, and how do state measures facilitate preservation of human-animal livelihoods



Animal-diversity: compare among field sites which animal occupies which socal niche, prestige, and socio-economic function for supporting pastoral livelihood in the Arctic?

Local participation: field work

First results: see ArcArk posters “Finnish Lapland”, and “Eveno-Bytantay”

In Collaboration

ARKTINEN TUTKIMUSOHJELMA
ARCTIC RESEARCH PROGRAMME

UNIVERSITY OF LAPLAND
LAPIN YLIOPISTO

Российская Академия Наук
- **ФГБНУ Якутский НИИСХ**
- **Институт Генетики и Разведения Сельскохозяйственных Животных,**
- **Северо-Восточный Федеральный Университет**

Juha Kantanen
Florian Stammler
Nasser Ghanem
Anna Gossmann-Stammler
Mervi Honkatukia
Nuccio Mazzullo
Anu Osva
Jaana Peippo
Kisun Pokharel
Tiina Reilas
Päivi Soppela
Ilma Tapio
Melak Weldenegodguad

Innokenti Ammosov
Matrena Baisheva
Catarina Ginja
Ruslan Popov
Aytalina Ivanova
Vladislav Konstantinov

Photos: Juha Kantanen, Anu Osva, Päivi Soppela, Florian Stammler