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2021

The 1st International Electronic Conference
on Biological Diversity, Ecology and Evolution
15–31 MARCH 2021 | ONLINE

Chaired by PROF. DR. MICHAEL WINK



Genetic characteristics of wild and domestic reindeer based on the analysis of mtDNA cytb gene



[Veronika Kharzinova](#)

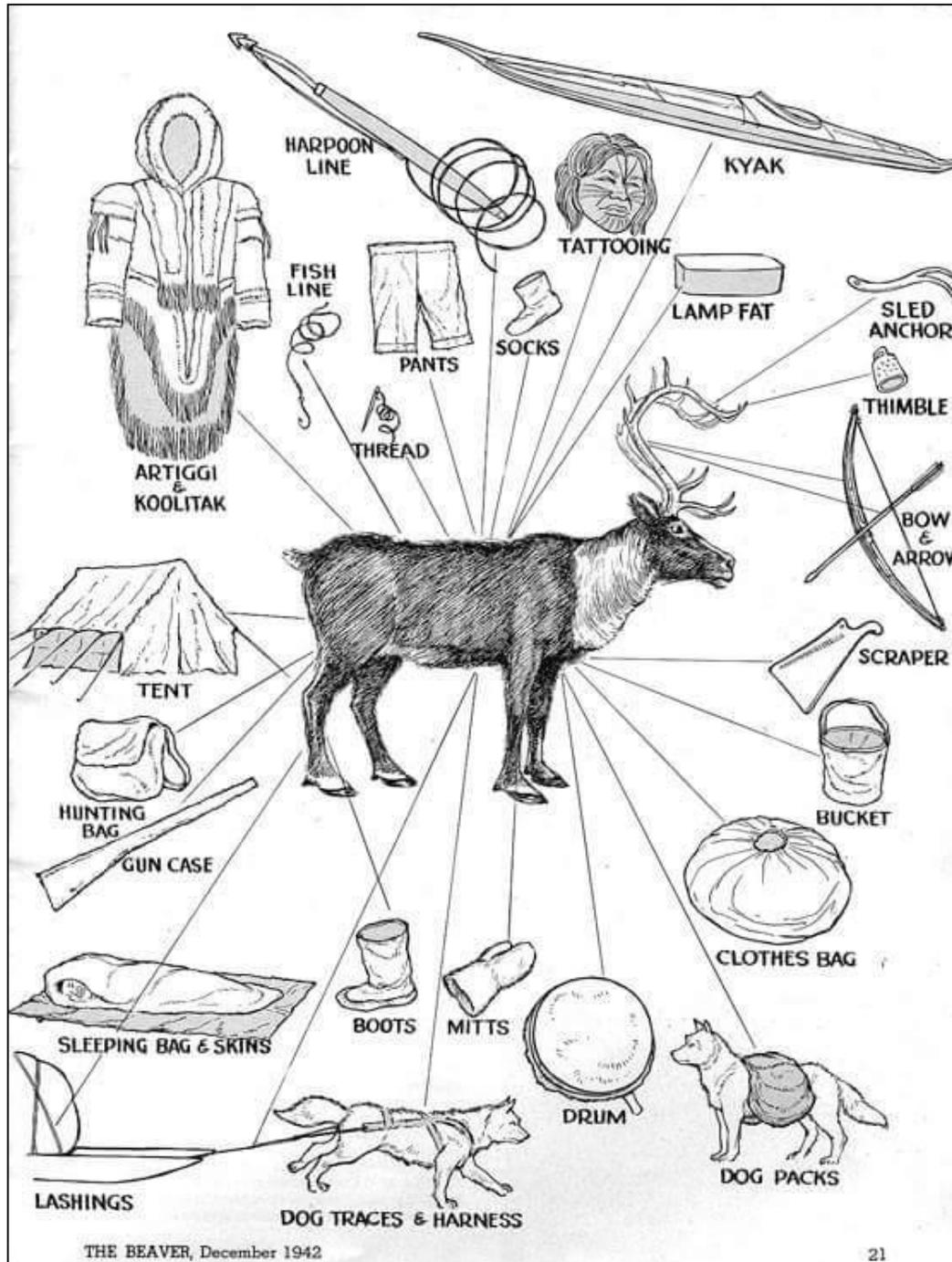
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**Federal Research Center for Animal Husbandry
named after Academy Member L.K. Ernst**

Podolsk, Moscow region, Russia

23/03/21





➤ Reindeer is an essential element of the Russian Northeast area ecosystem

■ significant source

➤ 16 indigenous minorities of the northern regions > 130 000 people

➤ deeply integrated into life and culture of indigenous northern people

➤ there are currently about 2.5 million domesticated reindeer

■ 9 countries

➤ the Russian Federation is the largest in terms of the number of domesticated reindeer

➤ domestic reindeer populations = 1,702,000



In Russia there are four reindeer breeds :

The Nenets



-is the largest one by number (1,300,800 heads) and pasture territory.

The Evenk



-is considered to be the oldest one. The total stock is no more than 20,000 animals.

The Even



-is well adapted to mountainous areas. The total stock is 154,000 individuals.

The Chukotka



-is characterized by a high meat production, a high adaptation to the arctic conditions. The total stock is 202,100 individuals

All these breeds were created as results of selection by northern communities and are characterized by specific behaviour as well as adaptation characteristics

The Tuva population

-is inhabiting the southernmost reindeer zone of Russia; differ from the breeds; is used as riding animals for hunting, as well as for obtaining dairy products. The total stock is 1,500 animals.



Wild reindeer population



- very important component of aboriginal economies and has significant cultural value
- its range comprises the entire tundra, forest-tundra, and taiga zones
- the main population is concentrated in two regions:
 - Taymyr region
 - northern Yakutia region
- the total number of the wild reindeer = 750,000
- the Taimyr reindeer herd-the largest reindeer population in Eurasia =500,000



The study of genetic diversity of reindeer has always interested scientists worldwide

It has followed the development of biochemistry and molecular biology:

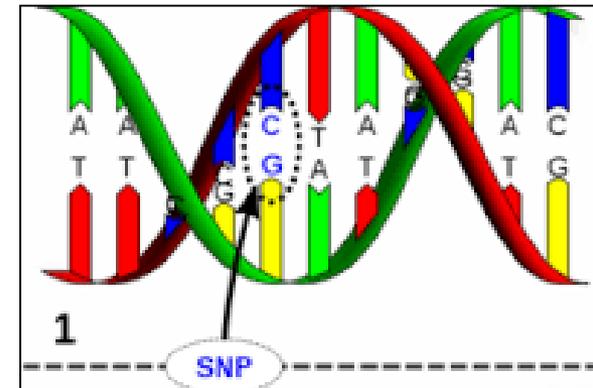
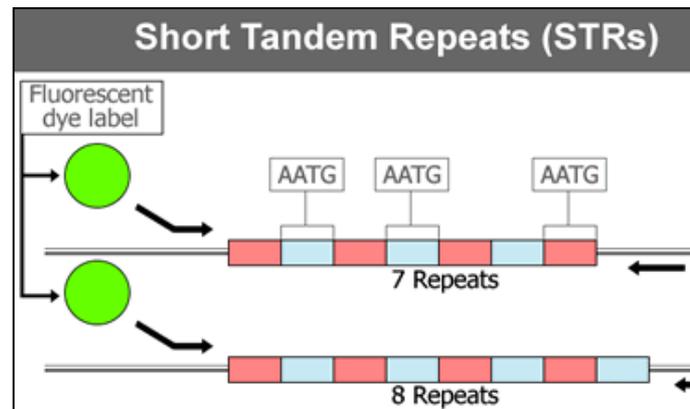
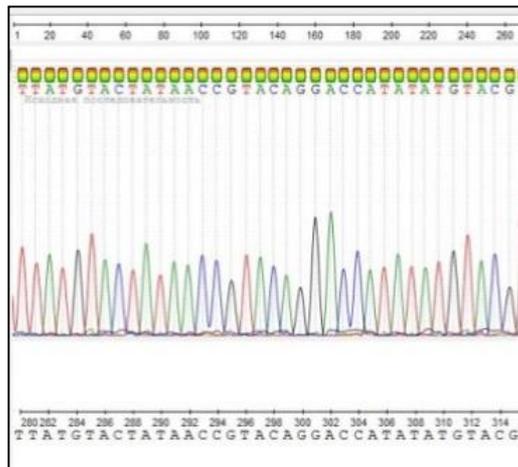
From the initial studies

The GEL ELECTROPHORESIS



to studies including

THE MITOCHONDRIAL AND NUCLEAR GENOME MARKERS



The own study of the genetic diversity of Russian reindeer populations – since 2014:

MICROSATELLITES

CAUSES: The demands from the farms to verify the reindeer origin

AIM: The development of multiplex panel of STR (14 STR) to assess the reliability of parentage assignment and the degree of differentiation of Russian native reindeer populations

RESULTS: The parentage verification; an estimation of diversity and population structure

AGRICULTURAL BIOLOGY, ISSN 24
2015, V. 50, № 6, pp. 756-765
(SEL'SKOKHOZYAISTVENNAYA BIOLOGIYA) ISSN 01
ISSN 23

UDC 636.294:575.174:575.113:577.2.08:51-76 doi: 10.15389/
doi: 10.15389/

**DEVELOPMENT OF MULTIPLEX MICROSATELLITE
THE PARENTAGE VERIFICATION IN AND DIFFEREN
OF REINDEER POPULATIONS (*Rangifer t***

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Acta fytotechn zootechn, 19, 2016(3): 87-92
<http://www.acta.fapz.uniag.sk>

**Estimation of biodiversity and population structure
breeds inhabiting Northeastern Siberia using micr**

Veronika R. Kharzinova¹, Arsen V. Dotsev¹, Anastasia D. Solovieva¹,
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Article Details: Received: 2016-04-25 | Accepted: 2016-05-26 | Available online

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213 Association of microsatellite profile with
phenotypic traits of semi-domesticated reindeer

V. R. Kharzinova, T. V. Karpushkina, A. V. Dotsev, A. D. Solovieva, T. M. Romanenko,
G. Brem, N. A. Zinovieva

Journal of Animal Science, Volume 95, Issue suppl_4, August 2017, Page 105,
<https://doi.org/10.2527/asasann.2017.213>
Published: 01 August 2017

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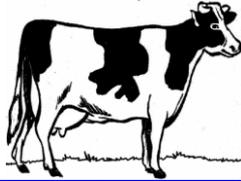
Abstract

Reindeer herding is the historical branch of animal husbandry in the northern
regions of the Russian Federation. There are four reindeer breeds, the most
numerous of which is Nenets (with over 800,000 reindeer). For further
development of the reindeer herding, in addition to traditional breeding
methods, it is necessary to apply modern technologies, such as genetic analysis.
The aim of the current work was to identify the possible association between

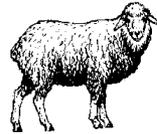
SNP MARKERS

The widespread use of single-nucleotide polymorphism markers as a powerful tool for addressing a great number of genetic tasks

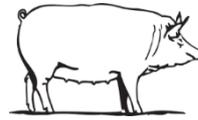
AN OBSTACLE: Reindeer is non-model species



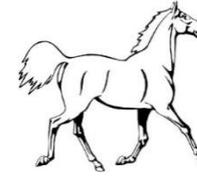
Bovine genotyping
BeadChip



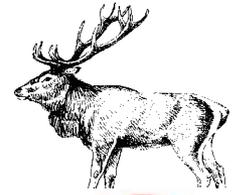
Ovine genotyping
BeadChip



Porcine genotyping
BeadChip



Equine genotyping
BeadChip



THE WAY OUT : Applicability of commercial DNA chip developed for domestic animals -Bovine and Ovine species to whole-genome analysis of reindeer

Journal of Heredity, 2015, 116(2):111-116
doi:10.1093/hered/ehv011
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American Genetic Association

Brief Communication

A Study of Applicability of SNP Chips Developed for Bovine and Ovine Species to Whole-Genome Analysis of Reindeer *Rangifer tarandus*

Veronika R. Kharzinova, Alexander A. Sermyagin, Elena A. Innokentiy M. Okhlopov, Gottfried Brem, and Natalia A. Zinovieva

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Conflicts of interest statement: The authors have nothing to disclose.

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Corresponding Editor: Tamas Dvornik

Abstract

Two sets of commercially available single nucleotide polymorphisms (SNPs) developed for cattle (BovineSNP50 BeadChip) and sheep (OvineSNP50 BeadChip) have been trialed for whole genome analysis of 4 female samples of Reindeer (*Rangifer tarandus*) inhabiting Russia. We found out that 43.0% of Bovine and 47.0% of Ovine SNPs could be genotyped, while only 5.5% and 2.05% of them were respectively polymorphic. The scores and the polymorphic SNPs were identified on each bovine and each ovine chromosome, but their distribution was not unique. The maximal value of runs of homozygosity (ROH) was 30.33 Mb for SNPs corresponding to bovine chromosome #1 and 40.57 Mb for SNPs corresponding to ovine chromosome #7. Thus, the SNP chips developed for bovine and ovine species can be used as a powerful tool for genome analysis in reindeer *R. tarandus*.

Subject words: Commercially available SNP chips, genome analysis

Key words: reindeer, *Rangifer tarandus*, SNP, whole-genome analysis

➤ Two commercially available SNP Chips have been trialed for whole-genome analysis of reindeer

A study of applicability of SNP chips developed for bovine and ovine species to whole-genome analysis of reindeer *Rangifer Tarandus*. Kharzinova V.R., Sermyagin A.A., Gladyr E.A., Okhlopov I.M., Brem G., Zinovieva N.A. J. Heredity, 2015.

Illumina Bovine SNP50
v2 BeadChip = 1257 SNPs

Illumina Ovine SNP50
BeadChip = 519 SNPs



llumina Bovine SNP50 v2 BeadChip

➤ The genetic characteristics of three domestic reindeer populations originating from the territory of the Republic of Sakha (Yakutia) was given

AGRICULTURAL BIOLOGY,
2017, V. 52, № 4, pp. 669-678

ISSN 2412-0324 (English ed. Online)

(SEL'SKOKHOZYAISTVENNAYA BIOLOGIYA) ISSN 0131-6397 (Russian ed. Print)
ISSN 2313-4836 (Russian ed. Online)

UDC 636.294:575.174.015.3

doi: 10.15389/agrobiol.2017.4.669rus

doi: 10.15389/agrobiol.2017.4.669eng

POPULATION-GENETIC CHARACTERISTICS OF DOMESTIC REINDEER OF YAKUTIA BASED ON WHOLE-GENOME SNP ANALYSIS

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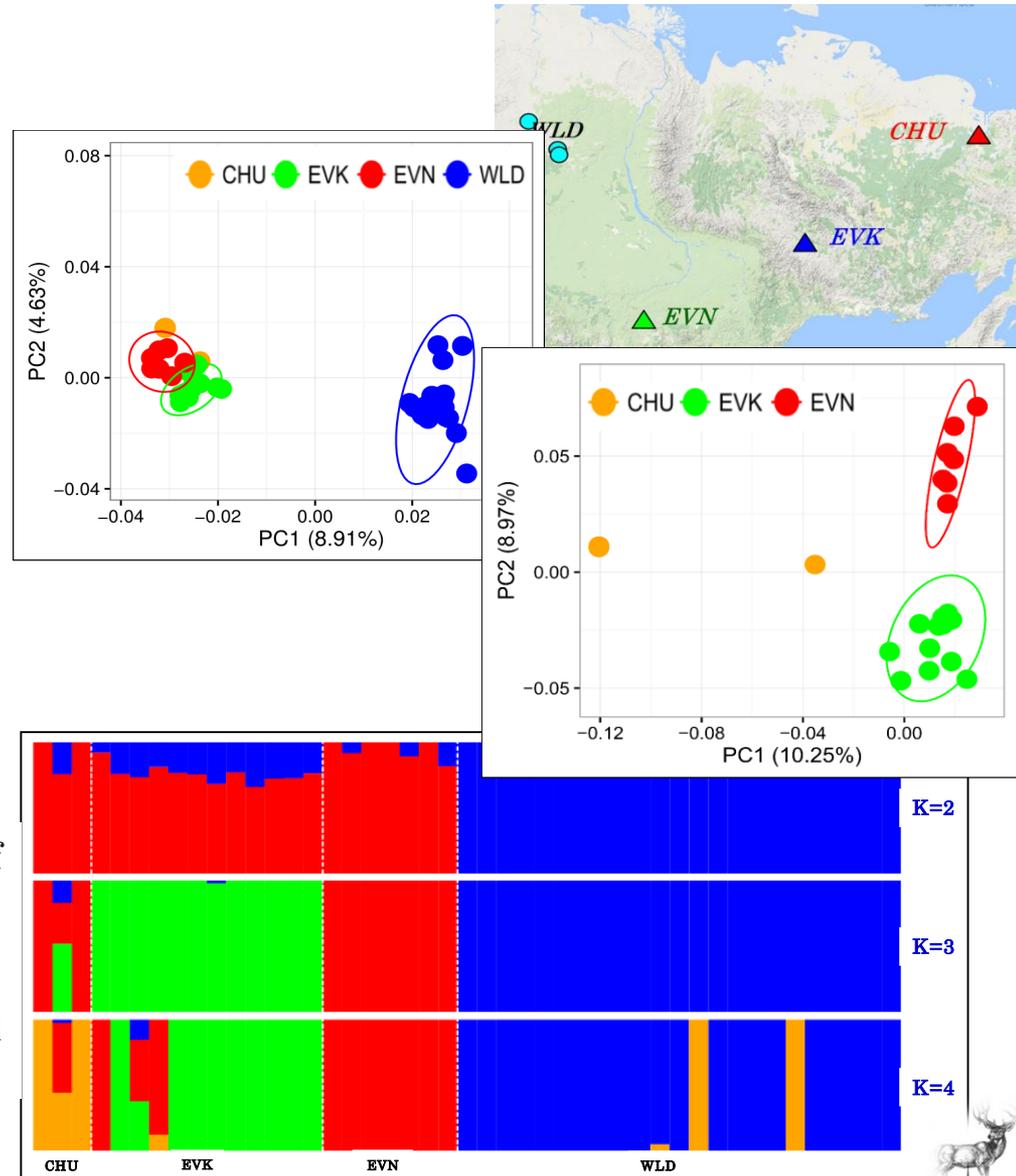
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The authors declare no conflict of interests

The population-genetic characteristics of domestic reindeer of Yakutia based on whole-genome SNP analysis. Kharzinova V., Dotsev A., Solovieva A., Fedorov V., Okhlopkov I., Wimmers K., Reyer H., Brem G., & Zinovieva N. Agricultural biology, 2017



ILLUMINA BOVINEHD BEADCHIP

➤ The clear genetic differentiation between domestic and wild reindeer populations was revealed

PLOS ONE

RESEARCH ARTICLE

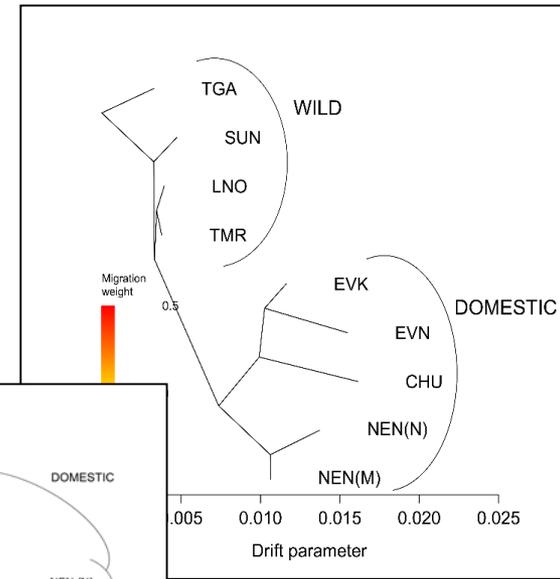
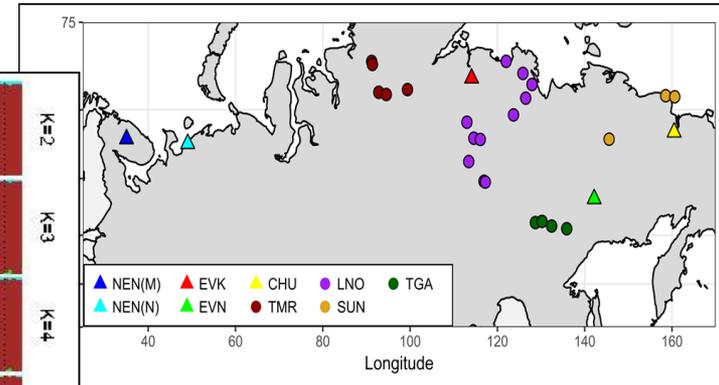
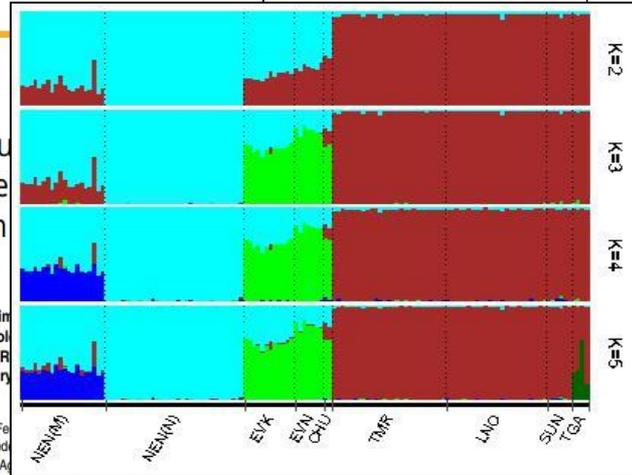
Genetic diversity and population structure of domestic and wild reindeer (*Rangifer tarandus* L. 1758): A novel approach using BovineHD BeadChip

Veronika Ruslanovna Kharzinova^{1*}, Arsen Vladimirovich Deniskova¹, Anastasiya Dmitrievna Soloviova¹, Kasim Anverovich Layshev², Tatiana Michailovna Romanova³, Michailovich Okhlopkov⁵, Klaus Wimmers⁶, Henryk Wozniak⁷, Anatolievna Zinovieva^{1*}

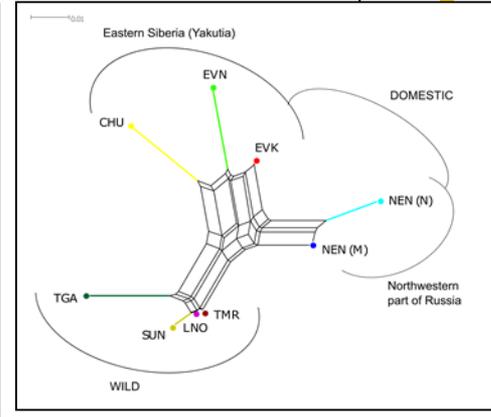
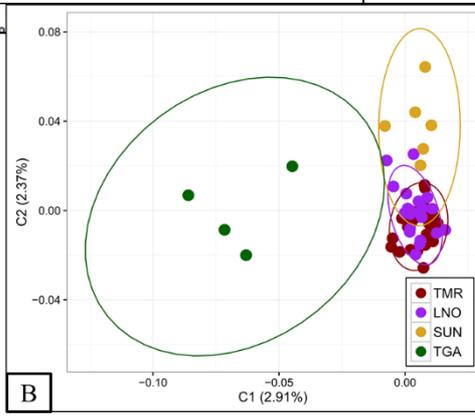
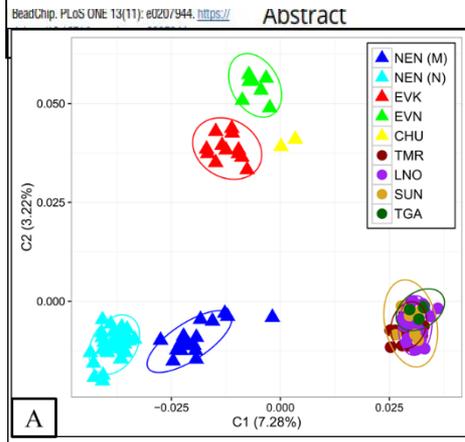
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Genetic diversity and population structure of domestic and wild reindeer (*Rangifer tarandus* L. 1758): A novel approach using BovineHD BeadChip. Kharzinova VR, Dotsev AV, Deniskova TE, Solovieva AD, Fedorov VI, Layshev KA, et al. PLoS ONE, 2018.



Illumina BovineHD BeadChip

- The deeper insight into the current intra-breeding reindeer genetic diversity was provided

Journals / Animals / Volume 10 / Issue 8 / 10.3390/ani10081309



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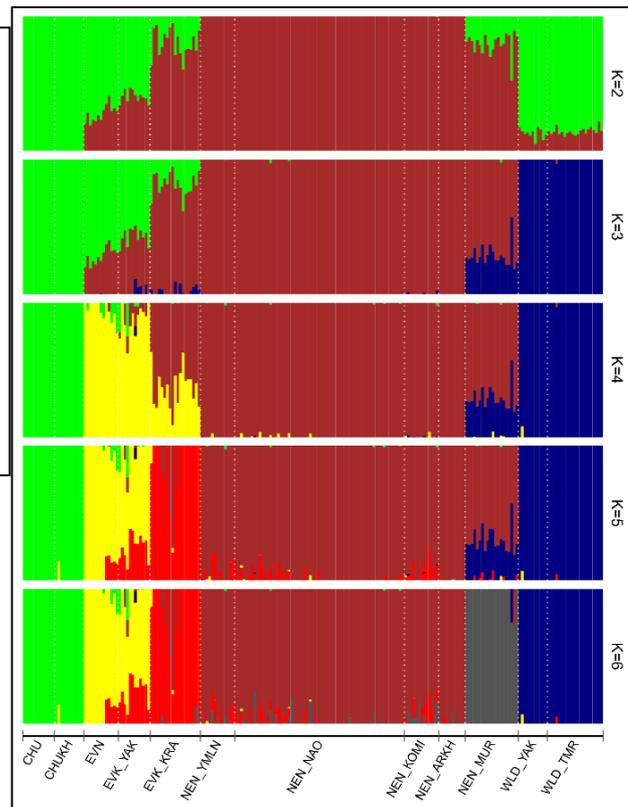
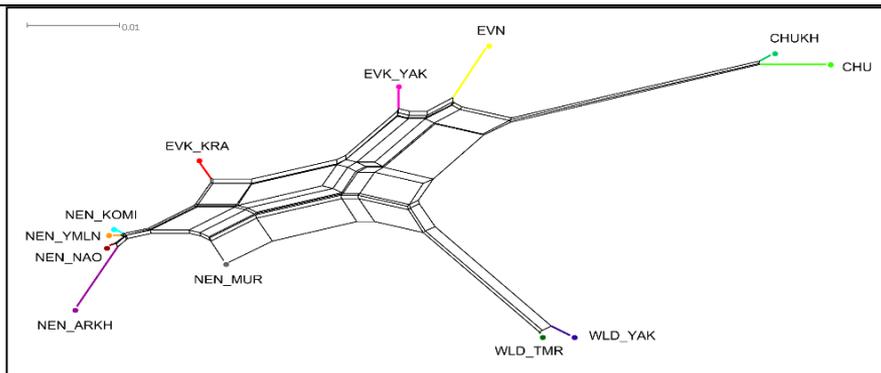
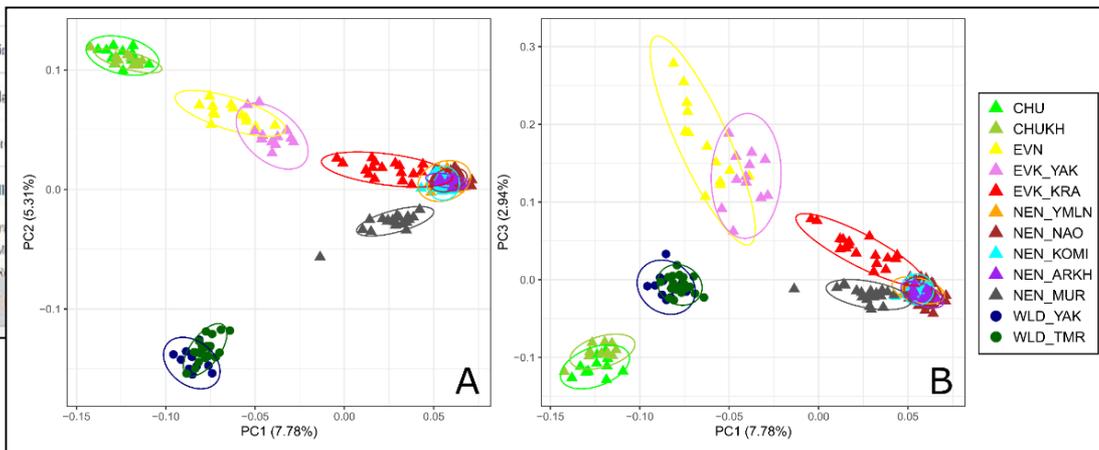
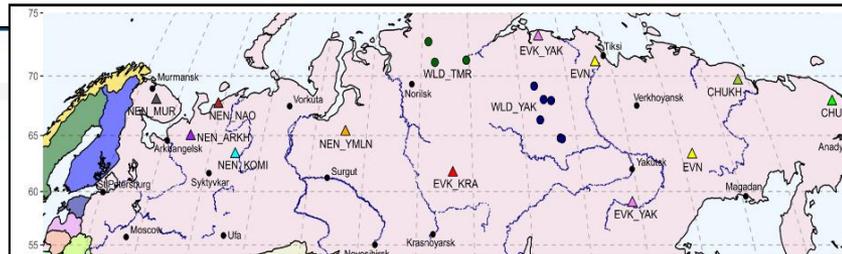
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Insight into the Current Genetic Diversity and Population Structure of

Insight into the current genetic diversity and population structure of domestic reindeer (*Rangifer Tarandus*) in Russia. Kharzinova, V., Dotsev, A., Solovieva, A., Sergeeva, O., Bryzgalov, G., Reyer, H., Wimmers, K., Brem, G., & Zinovieva, N. *Animals*, 2020



MTDNA ANALYSIS

AIM:

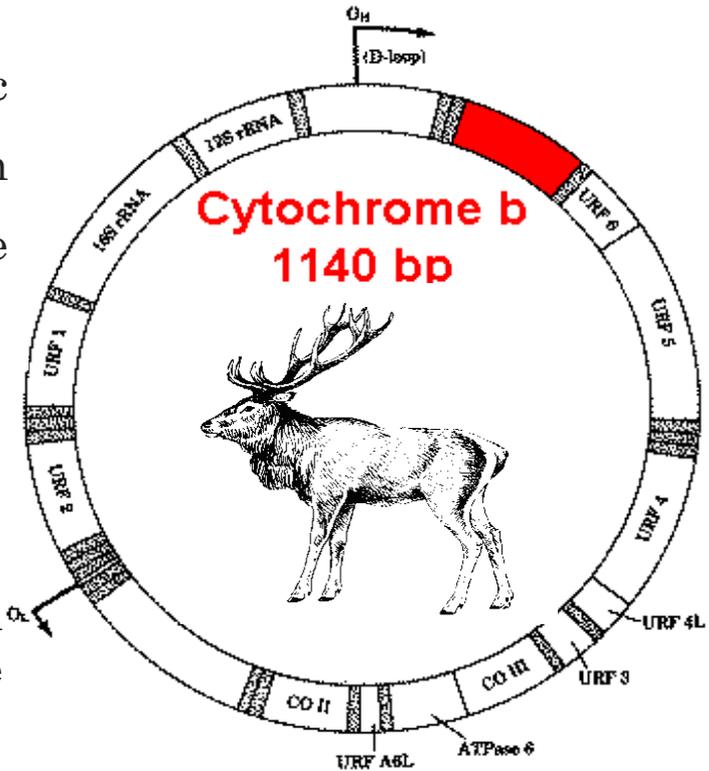
The determining haplotype variability and genetic diversity of the wild and domestic reindeer based on the analysis of mitochondrial cytochrome b gene sequences.

MATERIALS:

The wild reindeer of the Taimyr population (WLD, n=16) and domestic reindeer of the Nenets breed (NEN, n=15) and Tuva population (TUVA, n=5) were sequenced.

METHODS:

The whole sequences of cytb gene (1,140 bp) were analyzed by Sanger sequencing. To construct a median joining network, PopART 1.7 software was applied. Determination of the best models of evolution was carried out separately for each nucleotide in the program PartitionFinder 2 using the Akaike information corrected criterion (AICc). DnaSP 6.12.01 program was used to calculate genetic diversity parameters: number of polymorphic sites (S), average number of nucleotide differences (K), number of haplotypes (H), haplotype diversity (Hd), nucleotide diversity (π).



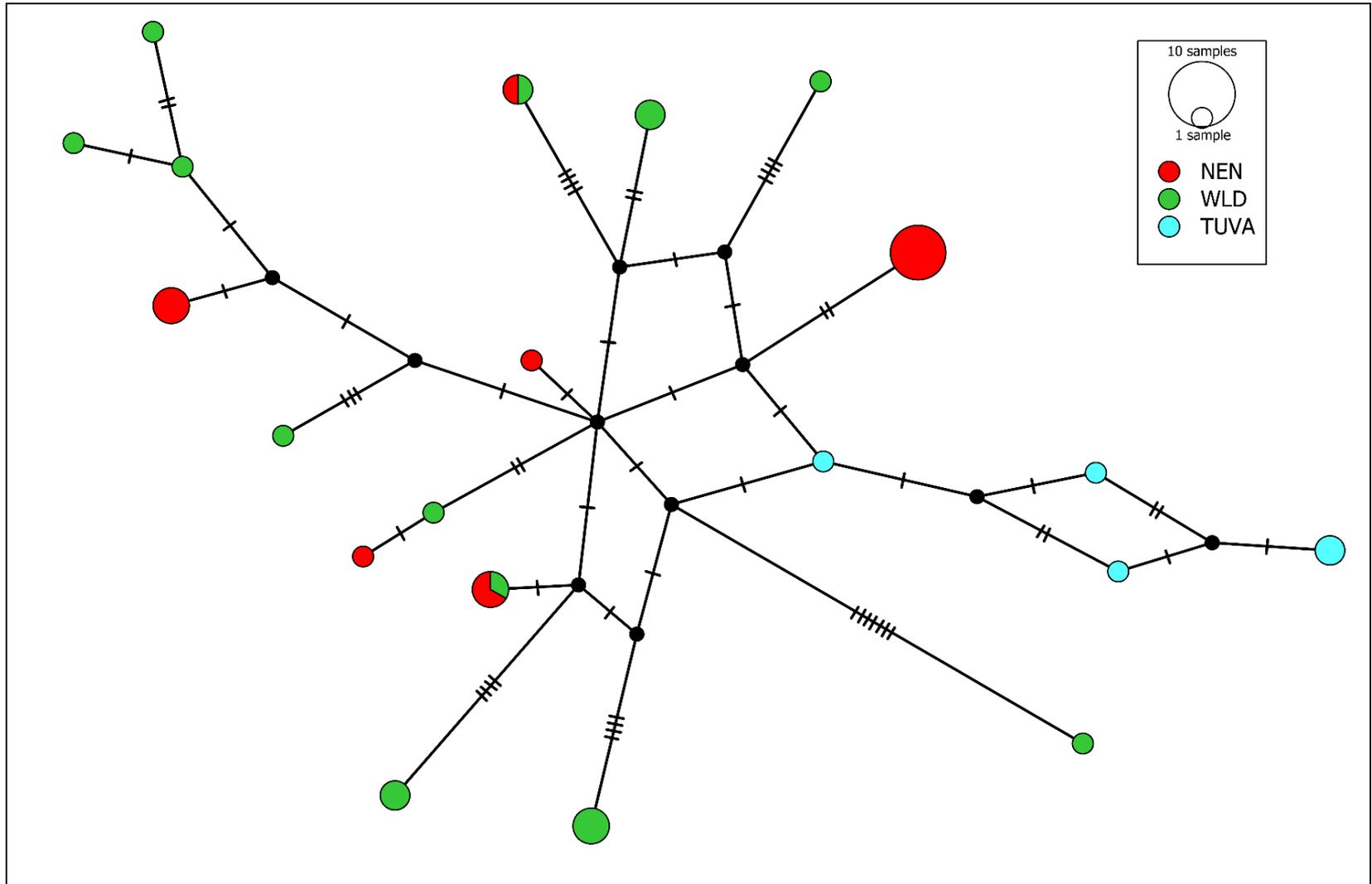
Genetic diversity indices of reindeer populations calculated from nucleotide sequence of mitochondrial cytb gene

Breed/Population	Code	n	S	H	Hd	K	π
Nenets domestic	NEN	15	17	6	0.762 ± 0.096	4.324	0.00379 ± 0.0006
Taimyr wild	WLD	16	35	12	0.958 ± 0.036	7.942	0.00697 ± 0.00052
Tuva domestic	TUVA	5	5	4	0.900 ± 0.161	2.800	0.00246 ± 0.00054

n—sample number; S—number of variable sites; H—number of haplotypes; HD—haplotype diversity; k—average number of nucleotide differences; π —nucleotide diversity.



Median joining network of reindeer populations based on the analysis of mtDNA cytb gene polymorphism.



CONCLUSIONS

- the wild reindeer were characterized by higher genetic diversity than both domestic groups
- the Tuva reindeer clustered separately from the other populations and were characterized by higher haplotype diversity than the Nenets reindeer
- the reindeer of the Nenets breed had a higher average number of nucleotide differences.
- First Step!

THE NEXT GOAL:

- the sequencing of the complete mitochondrial genome of reindeer populations inhabiting Russia



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The study was supported by Ministry of Science and Higher Education of the Russian Federation within theme No. 0445-2019-0024.





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