The Arctic Ocean and Its Coast in the Cenozoic Era

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Mammals and Landscape of the Northern Urals in the Late Anthropogene

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The Cenozoic history of the mammals of the Northern Urals has yet to be studied adequately. Paleontological data only indicate that in the Pliocene the Urals were inhabited by a *Hipparion* fauna. During the Quaternary the range apparently was covered at least twice by the ice of the Early Pleistocene (Oka) and Middle Pleistocene (Dnieper) glaciations. Until recently geologists believed that even the Last (Valdai) Glaciation extended to the Northern Urals.

The paleontological materials discussed in this paper were collected mostly on the western slopes of the Northern Urals and the southern part of the Pechora Lowland lying between 61 and 65°N. The bones were collected during geological explorations and archeological excavations by the research workers of the Komi Branch of the Academy of Sciences of the USSR, who explored nine caves and karst recess and one open campsite [1]. They were analyzed by this author in the Laboratory of Osteology of the Zoological Institute of the Academy of Sciences of the USSR. Of the 110,000 pieces of bone collected about 33,000 belonged to 39 mammal species of 15 families and 7 orders.

In the Late Pleistocene primitive man settled in the caves of the Northern Urals where fragments of bones of cave bear, hare, mammoth, rhinoceros, wild horse, reindeer, ox and other animals that served as his food gradually accumulated. In the Holocene the caves served as sanctuaries where numerous bones of sacrificed brown bear, wolverine, otter, beaver and elk are preserved. Bones of the prey of predatory birds and quadrupeds also were buried.

Comparison of collagen [2] radiocarbon analyses show that the fossil bones accumulated 15-20 thousand years ago: the mammoth bones from the Byzovaya campsite on the Middle Pechora gave an absolute age of

18,320 ± 280 years by ^{14}C. The upper, Holocene layers are well dated archeologically. They were deposited between 2000 B.C. and 1800 A.D.

Investigations revealed that at least 32 mammal species comprising a typical complex of "mammoth fauna" [3] (consisting of mammoth, wolf, Arctic fox, cave lion, cave bear, polecat, horse, rhinoceros, reindeer, ox, saiga, etc.) inhabited the Northern Urals in the Late Pleistocene. These beasts were adapted to life in different landscapes and biotopes. They may be divided into three groups. The first group, e.g. Arctic fox, polecat, steppe pika, collared lemming, horse, rhinoceros, saiga, ox, etc., consists of species adapted to life in open tundra and steppe landscapes. The second group includes widespread species, e.g. wolf, fox, cave bear, ermine, weasel, cave lion, mammoth, etc., adapted to life in various forest biotopes alternating with open spaces. The third group comprises species like brown bear, sable, wolverine, hare, squirrel, beaver, bank vole, elk, etc., habituated to life in closed forest biotopes.

Members of the first two groups form the majority both in number of species and in quantity of bones. The relative quantity of bones of each of them was worked out as percentages to tenths of 1 percent. Bones of the third group occurred sparsely and the relative quantity was expressed as hundredths of 1 percent.

Most of the above-mentioned animals of the first two groups do not endure a thick snow cover that hinders movement and food procurement [4]. For instance a snow cover more than 40 cm deep is a serious hindrance to a wolf hunting in forests [5]. The saiga finds it difficult to move about if the snow is 20 cm deep and a depth of 30 cm is critical [6]. The ox now survives in regions where precipitation in winter does not exceed 30 mm at any one time, indicating a very thin snow cover [7].

It follows from the foregoing that a forest-steppe or forest-tundra type landscape with an arid continental climate and hard ground in summer and thin snow cover in winter prevailed in the Northern Urals in the Late Pleistocene.

Spore-pollen analysis [1] suggests that in the Late Pleistocene the locality was thinly populated with the main forest-forming species *Betula* sect., *Albae* Rgl., *Pinus sibirica* Rupr. and *Pinus silvestiris* L. Small spruce groves apparently occurred in the fluvial plains or in the foothills of the Northern Urals. Of the herbaceous plants members of the thistle (genera *Aster* and *Artemisia*), willow-weed, grass and crowfoot families were dominant.

Collation of paleozoological and paleobotanic data rules out continental glaciation in the Northern Urals 15-20 thousand years ago—the Ostashkovo stage of the Last Valdai Glaciation in Scandinavia. It is possible that the Last Glaciation featured small mountain-valley and cirque glaciers concentrated mostly on the high peaks of the Northern Urals [8-10].

The modern fauna of the Northern Urals consists of 42 mammal species

[11]. It includes Late Pleistocene species surviving to this day (brown bear, sable, wolverine, squirrel, aquatic vole and elk), as well as species introduced during the Holocene (weasel, badger, otter and lynx).

On the basis of adaptability to different biotopes, the Holocene and modern species of animals may be divided into the following groups: 1) most abundant, consists of 23 species of typical forest dwellers; 2) consists of 12 species of less typical forest dwellers, widespread and adapted to living conditions of different biotopes; 3) embraces typical members of the tundra landscape, such as arctic fox and brown and collared lemmings. They are however very seldom found now in the Northern Urals. The spread of the remaining three species, viz. common mouse, gray rat and musk rat, was promoted directly or indirectly by human activities. Thus the fauna of the Holocene and modern beasts of the Northern Urals consist essentially of species habituated to the dark coniferous taiga landscape.

Paleobotanic studies revealed that the forest zone spread to its maximum in the Middle Holocene when the dark coniferous taiga extended to the Barents Sea Coast [12].

The evolution of the theriofaunal composition of the Northern Urals consisted of transformation of the forest steppe and forest tundra theriocomplex of the Late Pleistocene into the Holocene taiga theriocomplex. The primary causes of this change were evidently the warming of the climate, the increase in winter precipitation and the conversion of open landscapes into closed taiga landscapes. This resulted in the extinction of the typical Pleistocene beasts: mammoth, woolly rhinoceros, horse, bison and cave bear, which could not find the food they needed in the taiga, particularly in winter [13]. No small role in this was played by man whose hunting activities reduced the animal population. Ranges of many species belonging to open landscapes diminished in the Holocene. The arctic fox, collared lemming, reindeer and ox retreated to the north and northeast and the bright polecat, steppe pika and saiga to the deep south.

The change in the population ratio of different species also serves as proof of the change in Ural landscapes in the Late Anthropogene. The number of animals of relatively open landscapes (wolf, arctic, fox, hare, reindeer, hoofed lemming, etc.) decreased in the Holocene. For instance the wolf contributed 3.3% of the collections from the Pleistocene layers but 1.2% from the Holocene layers. The process of reduction in population continued during historical times and culminated in the total disappearance of wolves in the Central Pechora Lowland.

The relative arctic fox population was 23.6% in the Late Pleistocene but fell to 2.5% in the Holocene. Nowadays arctic foxes make their appearance in the area under study during winter in years of limited migration, which occurs once in three years.

On the other hand the relative population of animals of taiga land-

scapes (brown bear, sable, wolverine, mustelid, squirrel, beaver and elk) increased in the Holocene. For example the relative wolverine population was 0.4% in the Late Pleistocene but mounted to 17.0% in the second half of the Holocene. At present the wolverine is a common but numerically minor species in the Northern Urals. In the Pechora-Ilych Sanctury one wolverine occurs in 10,000 hectares of forest area [14]. The relative beaver population rose from 0.4% in the Late Pleistocene to 14.0% in the Holocene, that of elk from 0.08 to 12.0% and so on.

The mammals surviving the Pleistocene-Holocene climatic fluctuations in the Northern Urals developed various morphological and ecological means of adaptation to changed living conditions. One of these was the elongation of limbs of Holocene animals, primarily of the distal parts of their limbs, viz. the phalanges, metapodials and tibia and ulna. It is established that the tibia of the present-day arctic fox is 6-11% longer than that of his Late Pleistocene counterpart. All parts of the limbs of tundra deer are 2-9% longer than those of their Late Pleistocene ancestors. The change is particularly marked in modern forest reindeer; each bone of their limbs is 16-20% longer. The elongation of the limbs of present-day arctic foxes and reindeer was the result of natural selection arising from the greater thickness of the snow cover in the Holocene as compared with the Late Pleistocene.

Thus the change in species composition, relative population and morphology of beasts reflects the change in the climate and landscape in the Northern Urals at the Pleistocene-Holocene boundary.

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