

Mammalian species richness changes in the Northern Eurasia mountainous regions during the Late Pleistocene and Holocene

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Fossil faunas provide a wealth of information on mammal diversity and species richness in the past. This type of information is relevant to understanding future global warming/glaciation and its impacts on biota. These data are of particular importance in reconstructing the evolution of terrestrial ecosystems during the Late Pleistocene - Holocene (marine isotope stages MIS 5 – MIS 1). This period covers about 130 thousand years and includes in Eurasia: the Last Interglacial (optimum at 126 ka BP: MIS 5e), the Last Glacial Period (MIS 5d – MIS 2, 109 – 11.7 ka BP), and the Holocene Interglacial (MIS 1). Changes in the mammal assemblages during the Late Pleistocene and Holocene have been well documented in Eurasia. One of the most interesting phenomena during the Late Pleistocene are the Late Pleistocene extinction event of numerous mammalian species and collapse of unique mammal assemblages. The last ones included the species with very different environmental preferences. A nowadays relatively high diversity of mammals is a common characteristic of mountainous regions, including their foothills. This is a consequence of the high habitat diversity, which is expressed, for example, in the altitudinal zonation due to high variation of environmental conditions. In the Last Glacial Period the huge mountain glaciers partly covered most of the North Eurasian mountainous regions. These glaciers reduced the physical living space suitable for animals and changed the position of altitude zones.

In this study (grant RFBR 18-05-00076) we focused on the mammalian species richness changes in Pyrenees, Alps, Carpathians, Caucasus, Urals, and Altai-Sayan region between 130 and 3 kyr BP. Our paleontological database (PALEOFAUNA) contains species lists of about 2070 localities from the selected mountainous regions dated by time interval under studies. The more or less synchronous fluctuations of species richness were observed in many cases (Alps, Altai-Sayan region, Urals, Carpathians). The First maximum of species richness (~ 45 – 75 species) in these mountainous regions was

observed at the beginning of the time interval (MIS 5e-d: ~ 126 – 109 ka BP), and the last one (~ 60 – 80 species) – during MIS 3 (57 – 29 ka BP). The lowest species richness was observed in MIS 5c-b (~ 109 – 87 ka BP), at the end of MIS 4 (~57 ka BP), during the Late Glacial Maximum (MIS 2: 29 – 11.7 ka BP), and in the Holocene time (except the Urals). The only maximum of species richness was observed for the Caucasus (82 species) and Pyrenees (59 species) during MIS 3. In general, the species richness maximum was characteristic of the MIS 3 megainterstadial (= middle Würm = Middle Valdai = Karginisky megainterstadial) mammalian assemblages. According to the features of the evolutionary dynamics of species richness, the mountainous regions form three groups: 1) Alps, Carpathians and Pyrenees, 2) Caucasus and Altai-Sayan region, 3) Urals. To analyse the dynamics of faunal composition we used non-metric multidimensional scaling (NMDS). In all regions the dynamics of faunal composition (initial data were presented in a matrix of Jaccard dissimilarity coefficients between faunas from any pairs of different time scale intervals) described by the 2 – 3 numbers of independent variables (coordinates of multidimensional models). The first one (NMDS axis1) correlates with species richness (r : -0.93 – -0.80) for all the regions except the Urals. In addition, the first variable of models correlates with the “global temperature” parameter ($\delta^{18}\text{O}$, ‰) for Pyrenees (r = 0.57), Alps (0.74), and Urals (0.74). The second variable of models (NMDS axis 2) correlates with temperature parameter (Caucasus, Alps, Carpathians, and Altai-Sayan region) or with species richness (Urals).

The global climate change was a critical factor affecting species composition (but not species richness) in the Urals. Probably, the habitat diversity (a number of potential ecological niches) was the most important factor of species richness in the Caucasus, Carpathians and Altai-Sayan region. Ultimately climate changes influenced the species richness and species composition in the Alps and Pyrenees mountain range systems. The environmental conditions of MIS 3 provided the coexistence of species with different and opposite ecological preferences in the North Eurasian mountainous regions.