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The thesis is composed of four original studies:

Ice Age is not over! Paleobiogeography of Altai-Sayan mammals

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Aim To examine persistence of the Pleistocene fauna in Altai-Sayan region by analyzing differences in the mammalian species composition and ecological structure between recent and Last Glacial (LG) faunas together with analysis of environmental and geographical factors influencing the extinction rate.

Location Palearctic and Altai-Sayan region in Central Asia

Methods We performed (1) comparison of proportion of LG species in recent faunas of 11 Palearctic regions, (2) correlation of extinction rate to environmental and geographical factors and, (3) analyses of ecological structure of communities classified to biome and trophic categories, using Principal Component analysis (PCA).

Results Altai-Sayan showed the lowest percentage of locally extinct species (17 % of all LG species) of the examined regions, followed by Russian Plain (28 %), and Caucasus (33 %). Italian peninsula showed the highest proportion of extinct species (46 %). Extinction rate negatively correlated with the number of recent biomes in a particular region. Other factors (latitude, longitude, area, elevation, topographical heterogeneity, annual precipitation and temperature) did not show significant relationship to ratio of extinct species. We found no apparent differences in ecological structure of the recent eastern Altai-Sayan mammalian communities in comparison to LG assemblages.

Main conclusion Eastern part of the Altai-Sayan region could be considered a refuge of the LG mammalian fauna. Persistence of mammoth steppe fauna has been allowed by high landscape heterogeneity of the region. Composition of LG and recent eastern Altai-Sayan communities was characterized by the co-occurrence of grassland, desert and alpine species.

None of the analyzed LG assemblages showed affinity to tundra biome. Glacial fauna persists in areas where forest belt does not separate alpine grasslands from grassland-desert vegetation. “Non-analogue” glacial communities have their modern analogues in protected areas of eastern Altai-Sayan. These reserves should be granted high conservation priority.

Habitat requirements of the long-tailed ground squirrel (*Spermophilus undulatus*) in the southern Altai

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The long-tailed ground squirrels *Spermophilus undulatus* represent the most abundant burrowing herbivorous species in the southern Altai grasslands and are suggested to play an important role in the maintenance of this mountain ecosystem. The aim of this study was to identify the key features that influence their habitat use in the southern part of the Altai Republic (south-west Siberia, Russia). The research area represents a complete sequence of altitudinal vegetation zones from steppe, forest-steppe, forest, sub-alpine and alpine tundra. Our results suggest that *S. undulatus* prefers short-grass steppes, near the water source and with a thin layer of a chernozem soil containing a large amount of coarse clastics. The species strictly avoids forests and tolerates only a low density of bush cover. Altitude and exposure to sun do not represent significant factors in the habitat choice of *S. undulatus*. Neither the presence of pikas nor the presence of marmots influences habitat selection of the ground squirrels. Strong preferences for habitats near a water source may limit the distribution of the species to mountain areas. Degree of human disturbance was not a significant factor affecting distribution and the species even displays slight preferences for heavily grazed habitat near human settlements and roads. Intensive grazing prevents shrubs and forest invasion, keeps vegetation low and thus provides appropriate conditions for the ground squirrels, favouring an open habitat where predators can be easily detected by sight. Our results suggest that the habitat selection of ground squirrels may be determined rather by a protection from predators and burrowing conditions than by food availability.

Habitat preferences in gray marmots (*Marmota baibacina*)

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We examined habitat preferences of the southern Altai population of gray marmots (*Marmota baibacina*) in order to decide whether interpopulational differences in habitat use result from a specialization to different habitats. Considerable differences in habitat requirements among the gray marmot subspecies have been described; *M. b. kastschenkoi* possibly represents the only forest dwelling Palearctic marmot, recently derived from the southern Altai ancestors. Our results show that habitat use in southern Altai marmots is determined mainly by vegetation type, annual temperature and elevation. The ancestral population prefers short-grass steppes, avoids forests and its distribution is limited by annual temperature, which restricts their occurrence to the alpine zone above timberline. Habitat requirements of *M. b. kastschenkoi* differ from their steppe ancestors. The intraspecific differences thus result from different evolutionary histories of the subspecies. A recent speciation process in gray marmots probably was followed by the evolution of ecological requirements, resulting in adaptation to forest dwelling.

What could we learn about habitat conservation of endangered European sciurids using substitute species?

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Identifying of factors affecting species' habitat use is a fundamental step that should be taken before planning. However, finding of factors determining a species distribution in environments substantially modified by human activities is very difficult. Studying of so-called substitute species occupying unaffected areas may provide important insight into the problems facing their threatened counterparts. We tested influence of predicted climate changes and direct anthropogenic disturbances on habitat preferences of two Asian sciurids, long-tailed ground squirrels (*Spermophilus undulatus*) and gray marmots (*Marmota*

baibacina) inhabiting relatively unaffected grasslands of southern Altai Mountains. The Altai species represent ecological equivalents European sciurids, European ground squirrels (*Spermophilus citellus*) and Alpine marmots (*Marmota marmota*). We found that reactions of the both sympatric species to human induced habitat changes differ considerably. Whereas long-tailed ground squirrel prefers areas with high human disturbance, similarly to other ground squirrels, gray marmot is more sensitive to direct human activities and thus occupies less modified habitats. Distribution of long-tailed ground squirrel is determined mainly by the annual precipitation. Predicted increase of precipitation in southern Altai) would not have apparent influence on its available habitats. To the contrary, climate change represents the most important factor threatening marmot populations. Predicted warming by 1.8-2.8°C in the first quarter of the 21st century would cause almost a third reduction of their habitat area and severe fragmentation of alpine habitat. Our results emphasize the importance of climate changes and direct anthropogenic disturbances for conservation management of European ground dwelling sciurids. Conservation effort should focus on “future habitats” with optimal climate after predicted climate change in particular areas. Conservation planning of Alpine marmots should focus on identifying areas with suitable thermal conditions, where tourism and livestock grazing will be regulated. Tolerance to human disturbance observed in European ground squirrels is not an artefact of limited availability of optimal habitats. Predicted pattern of climate changes probably would not threaten European ground squirrel. Establishing a net of suitable short-grass habitat patches with proper management (e.g. livestock grazing) would be crucial for survival of this species.