INFLUENCE OF GEOLOGICAL FORMATIONS ON MAMMAL DENSITY AND DISTRIBUTION (A CASE STUDY FROM GORNY ALTAI, RUSSIA)

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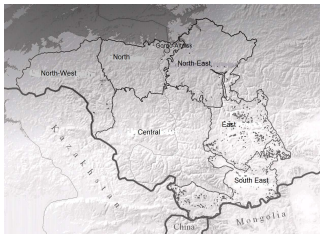
Introduction

There has been little research on how the composition of underlying rock formation affects animal species' distribution and abundance. The subject is worthy of consideration as it has been shown that ultrabasic and serpentine rocks in particular can give rise to plant biodiversity hotspots with a high level of endemism, and should be prioritized for conservation efforts, for example. Corresponding studies of fauna are lacking. We aim to test the hypothesis that rock type affects mammal abundance and biodiversity. Geophysical factors which could influence ecosystems include geochemical and geophysical anomalies, inhomogeneity of the Earth's crust: fault zones, accumulations of metal ores, underground water, changes in the exertion of rock.

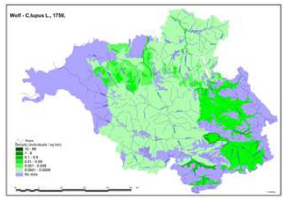
Methodology

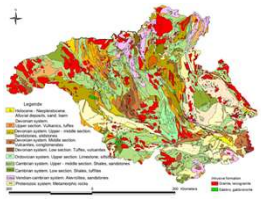
Data on the distribution of mammals in the landscapes of Gorny Altai has been previously collected [1]. The records are the result of extensive monitoring of mammal distribution from numerous sources over many years. Malkov & Belikov [2] extrapolated collected data to estimate the number and biomass of mammals in each landscape area. In this earlier study, the biomass of each species was calculated as the product of the number of each individual of that species multiplied by the average weight of the animal. Total mammal biomass was calculated by the sum of species' biomass. Average mammalian masses were calculated from data on the abundance and average masses of each species based on the concept of K - and K-selection [3]. To calculate biodiversity in the South-Eastern Altai the Simpson biodiversity index was used as the main index, and the Shannon biodiversity index as an auxiliary [4]. Additional indicators of community uniformity (uniformity of distribution of species) on Simpson and on Shannon (on density and biomass) were used. For the current analysis, extrapolated animal numbers / km^2 were used.

Figure 1. (below) shows the study area: Gorny Altai, a mountainous region in Russia



The wolf *Canis lupus*

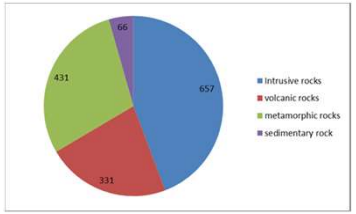




A digitized landscape map was used to visualize the distribution of species across the territory [5]. Data on the distribution of each mammal species was merged with the landscape database. The figure above left shows an example of the map produced for *Canis lupus* (wolf). Mila Utilities 2.0 (ArcView 3.2) was used to produce a "landscape complex" for each object on the map which was a composite measure of both landscape and geological features (incl soil type, climate, microhabitat), Above right: geological map showing intrusions in red

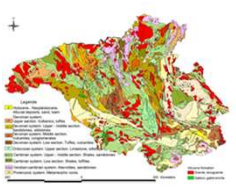
1. Malkov, Y. P., Shitov A.V. (2003). Theriological and geographical Atlas of South-Eastern Altai. Gorno-Altaysk: GASU, p30. (in Russian)
2. Malkov Yu.P., Belikov V. I. (1995). Mammals of the Altai Republic and Altai Krai. Gorno-Altaysk, p196 (in Russian)
3. Begon, M., Townsend, C. R., & Harper, J. L. (2006). Ecology: from individuals to ecosystems (No. Sirsi) i9781405111171).
4. Karanin A.V. (2004). Relationship of mammal biodiversity of the South-Eastern Altai province with geoecological characteristics of landscapes. Abstract Diss. ... PhD Gorno-Altaysk, p28. (in Russian)
5. Atlas of Altai Krai. Vol. 1. Barnaul – Moscow. 1978. (in Russian)

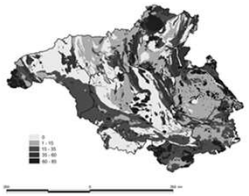
Results



Kendall's correlation coefficient revealed a number of significant negative correlations between geological composition and mammal density. Furthermore, differences in the extent of the correlations were found between magmatic, metamorphic and sedimentary formations. The highest number of significant correlations occur with intrusive rocks.

Here we have shown how the geochemical, geophysical, geodynamic specialization and other geological characteristics of the underlying rock influences mammal density and distribution. A characteristic feature of magmatic formations is their clear geochemical specialization, i.e. certain geochemical anomalies (Fe, Cu, Au, Hg, Ag, etc.) are confined to intrusions. We suggest that geophysical fields (magnetic and electric fields) and geochemical anomalies associated with intrusive rocks may have an impact on the distribution and species composition of mammals, as well as geodynamic processes such as fault activity.





Comparison of Geological map with number of significant correlations of rock type with mammal abundance .