Community organization and biodiversity of ants along an ecological gradient in Mongolia

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Aim Ants (Hymenoptera / Formicidae) have strong influences on ecosystems especially in arid regions. However, little is known about ants of the vast steppe and desert regions of Central Asia. Here we provide the first comprehensive study of ant communities in Mongolia, conducted along a north-to-south gradient in climate. We examined ants' distribution patterns and assessed the impact of climatic parameters on community structure and species diversity.

Hypotheses As in Mongolia gradients of temperature and rainfall run contrary from North to South, we expected no direct correlation of climate patterns and ant diversity. Ant community patterns should differ from those in hot arid places.

Location Mongolia occupies an ecological transition zone where the Siberian taiga forest meets the Central Asian Steppe and the Gobi desert. Located in the center of the Asian continent (see Fig. 2), Mongolia has a position leading to an extreme continental climate (Temp. –49 bis +40 °C) with very low precipitation, that decreases from North to South. This ecological gradient results in a mosaic of steppe, semi desert and desert sites (see Fig. 1).

Fig. 1 Vegetation patterns along our transect: steppe, semidesert and desert.

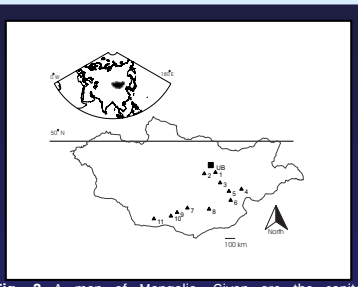

Fig. 2 A map of Mongolia. Given are the capital Ulaanbaatar and the positions of our study sites. The world map in the upper right corner shows the geographical position of Mongolia (black) in the centre of Asia.

Methods We observed 31956 ants at seed baits at 11 study sites along a transect from steppe to Gobi desert (Fig. 2) for which we attained meteorological data (mean yearly precipitation: 197 to 84 mm, mean yearly air temperature: -2.2 to 9.2 °C). Extra sampling was conducted at sugar and protein baits and by the inspection of different microhabitats. Vegetation patterns of each plot were recorded. Statistical evaluation comprised ordination and correlation.

Results We observed 15 species of ants at seed baits and altogether 26 ant species. Three faunal complexes of ants could be distinguished by detrended correspondence analysis (DCA, see Fig. 3): 1) in steppe baits were dominated by *Formica*- and *Myrmica*- species, 2) in semi desert we found mostly species of *Tetramorium*, *Myrmica*, *Proformica*, *Plagiolepis*, and *Leptothorax*, and 3) in desert *Cataglyphis aenescens* and *Messor aciculatus* dominated. Semi desert was an ecotone with intermediate ant species composition.

Assignment of taxa to functional groups showed that in steppe cold climate specialists dominated, in semi desert we found mainly opportunists, and in desert hot climate specialists (Fig. 4).

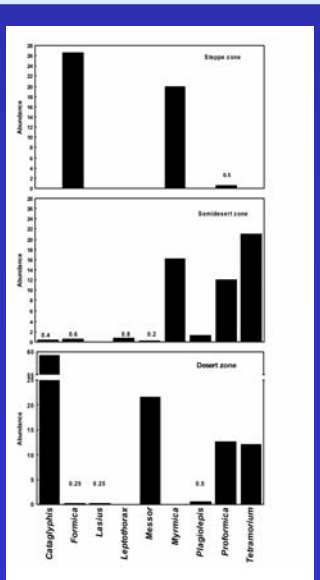

Fig. 3 The mean abundance of ant genera per plot in the different climatic zones. Abundance numbers below one are given in digits. Mind different scaling and scale break of the Y-axes in the lowermost figure. The abundance of ants in plots of different zones did not differ significantly (ANOVA $F(2,8) = 3.1$; n.s.).

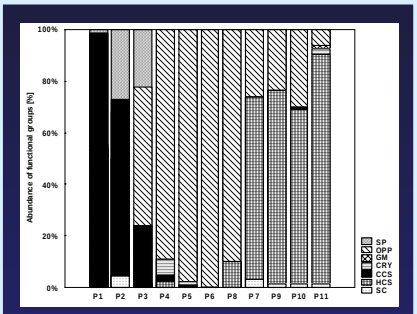

Fig. 4 Functional group composition along the North-South transect. The functional groups are: CSS Cold Climate Specialists, OPP Opportunists, HCS Hot Climate Specialists, CRY Cryptic species, SC Subordinate Camponotini, SP Specialist Predators, GM Generalized Myrmicinae. P1-P2 = steppe; P3-P6, P8 = semi desert; P7, P9-P11 = desert.

While plant species diversity was positively correlated with increasing northern latitude, ant diversity and ant species richness were not correlated with latitude and responded neither to precipitation, nor to any other climatic parameter (see Fig. 5).

Discussion Several functional groups know from arid zones in other parts of the world (e.g. Andersen 1997) were missing, diversity pattern were not linked to the productivity gradient. Both seemed to be a result of the low temperatures in Mongolia, thus confirming our hypothesis.

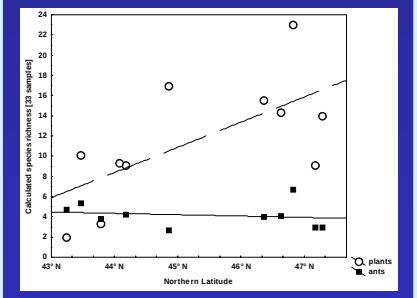

Fig. 5 Calculated species richness of granivorous ants and plants plotted against northern latitude. For easy interpretation we show the regression lines of these correlations between diversity and latitude: a) simple line = ants, b) dotted line = plants.

Main conclusions:

The ant communities in the Mongolian steppe and desert zones were strongly influenced by low temperatures and differed in many aspects from the ant fauna in other arid ecosystems, especially in terms of species richness, diversity of feeding guilds, and richness of functional groups.

Read more:

Pfeiffer, M., Chimedregzen, L. & Ulykpan, K. (accepted) Community organization and species richness of ants (Hymenoptera/Formicidae) in Mongolia along an ecological gradient from steppe to Gobi desert. Journal of Biogeography, **30**.

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References Andersen, A. N. (1997) Functional groups and patterns of organization in North American ant communities: a comparison with Australia. Journal of Biogeography, **24**, 433-460.