Determinants of ant species composition in a dryland ecosystem in Iran

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Background

Clarification of the mechanisms that cause diversity among assemblages is a key task in current community ecology. While patterns of alpha diversity of ants have been demonstrated at a wide range of scales, there is a surprising lack of knowledge about the mechanisms that cause beta diversity among ant assemblages, especially at a macro- ecological scale. We explored a 1200 km long transect across harsh arid and heterogeneous environments in Iran, to answer our focal question:

How does environment and space drive beta diversity in ant assemblages in arid Iran?

Our hypothesis:

Ant species composition varies significantly along the steep environmental gradient and can be largely explained by environmental parameters.

Methods

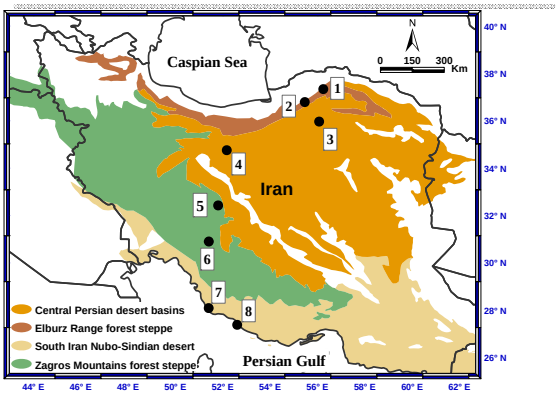

Fig. 1 Map of Iran, documenting eight sampling sites within four main ecoregions that were sampled along our north-south transect.

Fig. 2 Central Persian deserts basins (left) and Zagros Mountains forest steppe (right) ecoregions (plot Nr. 4 and Nr. 6 in Fig. 1, respectively).

The field work in Iran was carried out from May to August 2007. We collected ants from eight sample sites (Figs. 1, 2). In each sample site, we used a total of 60 pitfall traps, that were placed in two 300 m-transects. To identify origins of beta diversity, we applied variation partitioning method. We used Mantel *r* and Moran's *I* correlograms to inspect the spatial structure of ant assemblages.

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Results

We collected a total of 69 species/morphospecies. In total, spatial and climate variables together explained 62% of the species composition variation and left 38% unexplained (Fig. 3).

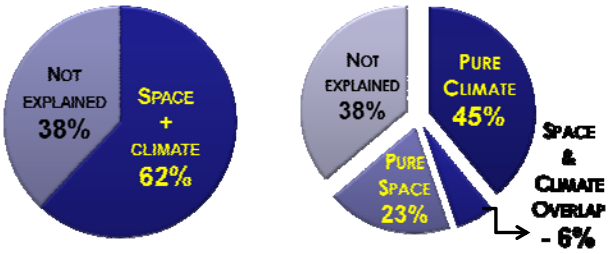

Fig. 3 Variation partitioning of species composition between two sets of explanatory variables: Climate variables and space.

Redundancy analysis of fraction "climate" retained three significant axes. The first two axes discriminated ant species composition in four groups (Fig. 4). The first axis, which can be interpreted as a summer rainfall gradient, discriminated the northern steppe from the remaining sites. The second axis, which was strongly correlated with annual rainfall, split ant species composition into three assemblages.

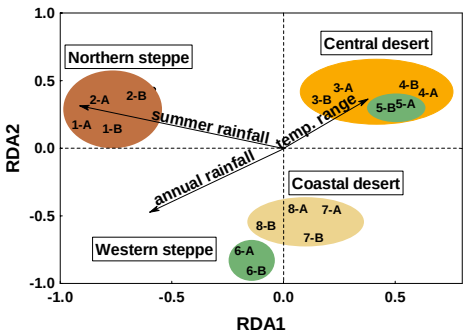

Fig. 4 Redundancy analysis (RDA) biplot of the first two axes corresponding to climate variation.

The ant species composition showed a significant positive spatial autocorrelation at the shortest distance (Fig. 5).

Conclusion

Our hypothesis is supported by variation partitioning analysis. However, the significant contribution of spatial processes suggests that ant community composition is also influenced by dispersal; especially over short distances, when environmental conditions are suitable.

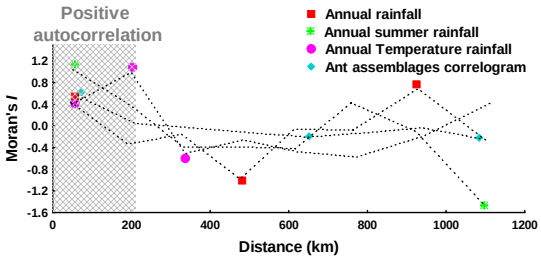

Fig. 5 Correlogram showing spatial correlation (Moran's *I*) for ant assemblages and three climate variables.