University of Venda

Ant diversity across an elevational gradient; functional versus taxonomic perspectives in the Soutpansberg Mountains, South Africa

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By

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Overall summary

Invertebrates constitute the bulk of ecosystem diversity. However, they are often ignored in conservation plans because of several shortfalls that include the lack of inventories and public awareness, a paucity of distribution and abundance data as well as their unknown way of life and sensitivity to habitat change. Environmental gradients are central in our attempt to address these shortfalls, gauging these organisms' responses to environmental change and ultimately in the search for general rules of community assembly.

In this study I focus on ants in a long-term monitoring study (5-year period) across an elevational gradient, that includes 11 sites on two climatically contrasting aspects of the Soutpansberg Mountain Range in Southern Africa. Ants were sampled using pitfall traps (September 2009 – January 2014) and baits (November 2011 and October 2012). Ants form a dominant component of terrestrial ecosystems, which both respond to and affects ecosystem processes, and this thesis aims to: 1) provide a check list and baseline data for ant species collected over a 5-year period across the study area, 2) report on the long-term biannual (wet and dry seasons) trends of species richness and test the relative contribution of geometric constraints, energy, available area, climate, local environmental variables, time, and space in explaining ant species richness patterns, 3) identify the relative role of spatial, environmental and spatially structured environmental variables in explaining variation in ant species turnover over the 5-year period of the study and 4) define a dominance hierarchy for ants species along the transect to describe variation of these dominance groups' abundance and distribution in space (elevation and habitat) and time (time of the day and season) and infer possible underlying processes structuring these assemblages.

Chapter One introduce ant diversity along environmental gradients and how its relevant to long-term monitoring. Chapter Two provides data on standardised pitfall surveys over the study period and yielded a total of 133 species in 38 genera and 6 subfamilies, with 21% of these species restricted to the southern slope of the mountain and 14% to the northern slope. Forty two percent of the species had significant indicator values (IndVal) larger than 70 and several of these were restricted to elevational zones pointing to a narrow and restricted distribution of several ant species along this altitudinal gradient. Observed richness was the highest at a low-altitude mesic and lowest at the summit site (sedgeland). Richness estimation and extrapolation, however, suggests an increase in richness at a southern aspect site 1600 m a.s.l. with increasing sampling effort.

Chapter Three reports on the large seasonal variability in richness with evidence of decreasing seasonal variation in species richness with increasing elevation. Diversity patterns across the study were mainly determined by geometric constraints and temperature while soil characteristics (clay and carbon content) accounted for smaller but significant amounts of the variation.

Chapter Four suggests that ant species turnover was consistently explained by spatially structured environmental variables followed by pure spatial variables while pure environmental variables explained less than 2% of the variation, except for one survey that followed an extraordinarily wet period. The spatially structured component reflects the strong gradient along the transect. The importance of space points to the importance of mass effects or some environmental variables which were not measured, particularly factors that vary at finer scales such as competition. Energy proxy variables (NDVI, Mean Monthly Temperature, and Minimum Monthly Temperature) consistently explained most of the variation in ant species turnover.

Available area, soil characteristics (percentage clay in the soil), also contributed to the explanatory power of the models.

Chapter Five reveal that dominant ant abundance increased with elevation, experienced seasonal decrease in winter and had a daily minimum during the warmest part of the day. The abundance of subdominant ants was highest at mid-elevational short forest site (1200 m a.s.l.) and was also highest during the warmest part of the day, while subordinate ants were present together with dominant ants throughout the day except in the morning. Subordinate ants had the highest abundance in woodland habitat.

Chapter Five also shows that various mechanisms might affect alpha diversity at a site across environmental gradients. On top of the mountain (sedgeland habitat), dominant ants control species richness at baits through competitive exclusion while habitat heterogeneity together with low abundance of dominant ants (open woodland habitat), environmental filtering (short forest habitat) and disturbance (shrubland habitat) might structure ant assemblages in the remaining habitats of the study area.

Across the study area, predicted increases in temperature should see an increase in species richness on the mountain but indicator taxa associated with high elevations are predicted to become locally extinct. Although ant assemblage responses were mainly driven by energy, structural changes will be confounded by the effects of bush encroachment on the southern aspect that will act as a filter while thermal tolerance limits will determine the response of species on the north. Developing a functional classification for the ants of the mountain might provide a more predictive framework for both assemblage and ecosystem functioning.