

Review of Petr Klimes Ph.D. thesis entitled "Diversity and ecology of arboreal ant communities in a tropical lowland forest"

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I enjoyed very much reading the thesis of Mr Petr Klimes. It brings numerous new contributions to the field of tropical ants community ecology. The style is very clear, concise and precise. The statistical analyses are sound, cautious and conservative. This is particularly important for studies of this type where priority is put into obtaining a complete inventory of a very rich and heterogeneous assemblage rather than replicating incomplete surveys. The conclusions are totally supported by the results obtained. The references are up-to date.

Strengths of the thesis

The main strength of the thesis is that it relies on outstanding datasets -by far the most complete available to date- on the diversity, distribution and nesting preferences of arboreal-dwelling ants in tropical forests. This information was put in relation with environmental characteristics of the habitat, particularly the density, size, and taxonomic composition of the trees. A single, large, dataset is analyzed in chapters 1 & 2 while another one, of unprecedented size as well, is used in chapter 3 to evaluate a new method of ant exclusion in the field.

The approach developed to obtain these datasets and to conduct the analyses is very smart, innovative and powerful. The "whole forest experiment " consists in completely sampling relatively large area of tropical forest. This approach is very-labour intensive and destructive but allow to obtain ecological informations with unsurpassed levels of details. Socio-economically it provides labour to local communities and generates critical scientific information from areas which will be deforested anyway for gardening. These large datasets were exploited ingeniously. In particular, in chapter 1, subsets of data were constructed to compare the contribution of the tree density, size and taxonomic composition in differences of ant diversity between primary and secondary forest.

New contributions to the field

New contributions to the field are numerous:

- A low mean arboreal ant diversity per tree was demonstrated. It was found that on average 3.6 species were present on trees, with 1.5 species effectively nesting in them. No difference was observed between primary and secondary forests despite large structural differences in the two forest types. This contrasts with figures obtained by less precise sampling methods used so far (e.g. insecticide fogging);
- The factors explaining differences in species diversity between primary and secondary forests were clearly identified for the first time. By decreasing importance, they appear to be: the beta diversity between

trees (due to microhabitat heterogeneity), the tree taxonomic diversity (especially at species level), the tree density and the tree size which are higher in primary compared to secondary forests;

- The true proportion of trees with nests and the proportion of ground nesting ants in trees were obtained and appear lower than thought before. The study demonstrates for the first time that either in primary or secondary forests, many arboreal ant species forage massively in trees where they are not nesting;
- For the first time also, the nesting preferences of all the ants of the assemblages present in primary and secondary forests were obtained;
- Finally, chapter 3 presents a new method to selectively exclude ants from rainforest plots. This is the largest manipulative treatment of ants attempted to date and it opens new ways for studying the role of ants in complex ecosystems.

Weaknesses

None. The only compromise is that there is no (ch.1 & 2) or low (ch.3) plot replication. However the lack of replication is considered carefully and largely compensated by the detailed information obtained in the study plots which already represents a monumental work.

Perspectives

The study opens many perspectives. The datasets collected are rich in key informations useful for further studies for example on the role of species interactions in structuring ant communities or on the role of ants in limiting herbivory.

Conclusion

I was impressed by the very high quality of this thesis. It is further impressive once one consider the difficulty of obtaining information on organisms living in complex environments and in tall tropical trees. The thesis addressed fundamental questions: Which factors determine the difference in ant diversity between primary and secondary forests? What is the importance of nesting microhabitat availability and diversity? How can we exclude ants from large areas of tropical forests during manipulative experiments? With its unsurpassed level of details, this thesis will certainly remain a reference for further ecological studies. In terms of conservation, it demonstrates the relevance of maintaining primary vegetation to conserve native ants.

I strongly recommend the award of Ph.D. title to the candidate Petr Klimes.



Maurice Leponce, Brussels 9^{Sep.} Oct. 2011

Questions to the candidate

- 1) In your conclusion (p.85) you state: "*the results of the thesis demonstrated high beta diversity of ant assemblages between individual tropical trees, evidently supported by great microhabitat heterogeneity in forest canopies. This result seems to contradict the assumption that inter-species interactions, plant diversity, tree size and density are the main factors structuring ant communities at local scales. Instead, it suggests the importance of nesting microhabitat availability and diversity.*" You tested the effects of plant diversity, tree size and density but not of inter-species interactions. In such case can you really minimize its importance? I look forward for a spatial analysis of your dataset and a test of species co-occurrence on trees.
- 2) Corollary to the first question, it is striking to find trees totally devoid of ant colonies (p.15). In the ant mosaic theory they are called "no ant's land". Did you collect informations that enable to understand why some trees remain ant-free?
- 3) I'm fascinated by the overdominance of *Crematogaster polita* in primary forests. According to my preliminary tests this species tends to develop supercolonies. This is consistent with your hypothesis (p.45) of a single polydomous colony in your primary forest 0.32ha plot. The overdominance of *Cr. polita* in the Madang area is also obvious in a canopy fogging study conducted by Olivier Missa in the nineties. By contrast, this species was little present in your ant exclusion plot in primary forest. Do you have any explanation for that? Would you have additional information on the geographical and altitudinal distribution of this key species? Do you have any explanation for the absence of *Cr. polita* in secondary forests?
- 4) Why did you calculate an estimator of total species richness (Chao 2) for your 0.32 ha plots since your survey in these plots is exhaustive and should therefore already provide this value ?
- 5) Minor point: In the introduction, p.11, you say: "*Ants belong to the most (...) diverse insects in tropical rainforest canopies*". Is it really so? Don't you think that other arthropod groups might be more species rich?
- 6) Did you notice differences in the herbivory pressure between the ant-excluded plots and the controls?

PHD THESIS REVIEW

Student's name: **Petr Klimeš**

Title of Thesis: **Diversity and ecology of arboreal ant communities in a tropical lowland forest.**

Supervisor: Prof. RNDr. Vojtěch Novotný, Ph.D.

Year: 2011

The thesis written by Petr Klimeš is a unique study of tropical arboreal ant communities and very valuable contribution to our knowledge on biological diversity of tropical insects. Despite the great advantage of biodiversity research during last decade there are still gaps in knowledge on processes that formed species richness and distribution of the most diverse group of organisms – insects. Some of the previous studies demonstrated significant relationships between insect diversity and various environmental traits but there is still lack of well-designed complex projects studying correlations between diversity of various groups of organisms with different position in trophic chain. I am considered that Petr Klimeš under supervision of Vojtěch Novotný and Milan Janda provided the great example of such study with very interesting outcomes.

Presented work comprises general introduction, one published papers (Ecological Entomology), submitted paper (Diversity and Distribution) and manuscript. The author collected great amount of material using very sophisticated experimental design. I would not surprise if the attached manuscripts would be accepted without major revisions and would become highly cited works very soon.

Chapter Introduction includes clear description of the main issues, identifies gaps in our knowledge on ants diversity, distribution and nesting preferences. Author is familiar with the most of major published sources, accurately summarizes and integrates the information and thus he provides strong justification for his research, clarifies study questions and, when relevant, provides clear defendable hypotheses.

An experimental design of the research was specific and comprehensive to the hypotheses and demonstrates clear understanding and proper use of modern ecological methodology. Especially experimental suppression of ants is fascinating method which gave very interesting results. Data analyses used in the thesis are sufficient and in accordance with recent quantitative ecology. Charts

as well as tables are sophisticated and instructional. Also photos are high-quality and very useful supplement of the work.

Results are interpreted in the light of the proposed research questions and existing literature. Discussion of results is also focused and connected to research questions. Implications for future research are discussed in Summary.

Ideas are expressed with exceptional clarity and logic. Presentation is coherent with minority of typos and grammatical errors. There is logical progression of thoughts within overall thesis and within each section.

I have one question to the author. Did he collect quantitative data on myrmecophilous species found in ant nests during the research? I am considered that such data could bring very interesting information on ant biology, diversity of nest microhabitats and relationships with host plants (e.g. myrmecophilous aphids, butterflies etc.)

In my opinion, the thesis of Petr Klimeš represents great original research study and I am sure that it meets all requirements for Ph.D. thesis. Author is able to formulate hypotheses, suggest appropriate experimental design, analyze the data and interpret the results of the analyses.

In Ostrava, August 29th 2011



Pavel Drozd

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