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Pagi Toko:

Ecological trends in geometrid moth communities along elevational gradients in tropical rainforests with lessons for tropical biodiversity conservation

Pagi Toko's doctoral thesis consists of two distinct but logically related parts: a study of the community of geometrid moths, a model, highly diverse taxon of insect herbivores, along rainforest elevation gradients, and a perspective on the conservation by indigenous peoples in the tropics, with a particular focus on Papua New Guinea.

The first two chapters examine the alpha, beta and gamma diversity of geometrid moths along two elevation gradients in Papua New Guinea. This study addresses the 200-year-old but still unsatisfactorily solved ecological problem that Alexander von Humboldt formulated in modern terms for plants: What drives changes in highly diverse ecological communities along elevational gradients in the tropics? A comprehensive global analysis of ecological drivers specifically for geometrids published by Jan Beck et al. in 2017 (*Global Ecol. & Biogeogr.* 26: 412), to which P. Toko also contributed, concluded that “single or clear sets of drivers are elusive”. The present Thesis represents a valid, if not definitive, attempt to make progress in solving this problem. It uses standard sampling methods for a widely used model taxon, but it stands out from similar studies in two ways: It samples communities along a complete rainforest elevational gradient from lowlands to timberline at 3,700 m a.s.l., and it uses a combination of abiotic and biotic explanatory variables, including quantitative data on both plant resources and predators including ants, birds, and bats.

The study was remarkably successful in representatively sampling highly diverse communities, as the species accumulation curves show. It is also thorough in its taxonomic analysis, combining morphology, supported by taxonomic expertise, with intensive molecular barcoding of species. In total, the study deals with 1,317 species of geometrids, more than the entire known fauna of the neighbouring island of Borneo. This great diversity, which requires intensive sampling, also comes with its own drawbacks and limitations, particularly the limited number of elevations, and elevational transects that could be sampled. This is perhaps the main reason why the analysis of elevational drivers remains an unfinished task that invites further study. The two chapters of the dissertation, one of which has already been published, are a good inspiration for such further investigations.

Papua New Guinea is a unique research environment, not only because its largely forested montane landscapes provide numerous long elevation gradients for study, but also because it is a natural laboratory for indigenous conservation in the tropics. Traditional land ownership has remained largely intact during the relatively short colonial period and has been legally recognised by the independent state of Papua New Guinea, giving numerous indigenous communities, speaking more than 800 different languages, unprecedented control over the rainforests that form the third largest remaining rainforest block in the tropics. This promising situation has not led to comprehensive and uncontroversial protection of the forests as might have been expected by the international research and conservation community, which often has rather unrealistic and idealistic expectations of indigenous societies and their priorities. P. Toko, a member of academia who comes from an indigenous community and has worked with many other indigenous communities in Papua New Guinea during his research, is in a unique position to analyse the strengths and weaknesses of indigenous conservation, explain its less than stellar record in Papua New Guinea, and highlight its future possibilities. This is the theme of the third chapter, which extends the Papua New Guinea experience to other indigenous communities by drawing on collaborators from indigenous communities and academic communities from other continents. With all due respect to the seriousness of the ecological problems with geometrid communities, this chapter, which is as yet unpublished, may represent the most lasting impact of this dissertation.

Pagi Toko's dissertation has demonstrated his ability to conduct independent ecological and entomological research of an international standard. Furthermore, he has demonstrated his ability to analyse (conservation) problems at the interface between biology and society and to approach the difficult problems of tropical biodiversity conservation from an intellectually stimulating but also practically useful perspective. I therefore recommend that Mr. Pagi Toko be awarded a doctoral degree on the basis of the dissertation submitted.

Vojtěch Novotný
PhD supervisor