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Philip T. Butterill: Tri-trophic interactions of host plants, gall-forming insects, and their parasitoids in the tropical rainforests of Papua New Guinea

The PhD dissertation by Philip Butterill is a result of a long journey which had started with an epiphany in front of a computer screen that led, after 10 years of code writing, to Phil's departure to jungles of Papua New Guinea, first as an unpaid volunteer, then becoming the first overseas PhD student in our Czech team. It all ends now back in front of a computer screen, with the present PhD thesis.

For me, as mostly an observer, and only occasionally a rather ineffectual guide, it has been a highly satisfying journey. The resulting study represents, as far as I know, the first modern, quantitative study of rainforest communities of gall-makers, where species are classified according to both galls and the insects that make them, the community patterns are related to the phylogeny of their host plants, and the natural enemies, particularly parasitoids, of gall-makers are also considered. We have seen similar studies for miners, and other guilds of folivorous herbivores, but the gall makers have proven to be more difficult.

Galls have always been a rather conspicuous and fascinating herbivorous guild, but also the one difficult to study. Butterill's work thus provides an insight into a taxonomically almost completely unknown group, as it deals with herbivores and their parasitoids that are virtually all new species to science. The study applies a solid combination of classical taxonomy and DNA barcoding, resulting in taxonomic papers with descriptions of new species and genera, as well as a new record for an entire insect family in the Oceanic biogeographical region (Chapters 4 and 5). This taxonomic foundation was used for the main, ecological, analysis of gall making guilds on tropical trees (Chapter 1, published in *Ecological Entomology*). The analysis highlights an ecological puzzle of relatively low species diversity of gallers per tree species which, combined with extremely high host specificity, and large diversity of plants in tropical forests, still translates in the high overall species richness of gall makers estimated for the tropics. This result leads to the revision of the common wisdom that gall makers are most diverse in subtropical dry areas, and makes hypotheses explaining this putative subtropical diversity peak obsolete. Butterill shows that tropical rainforests are the most diverse after all, even for gall makers.

The yet unpublished Chapter 2 is even more interesting, as it provides the first quantitative tri-trophic food web comprising tropical forest gallers, together with their host plants and parasitoids. It is probably the first example of interaction web from a tropical rainforest where extremely specialized parasitoids are attacking also extremely specialized herbivores, often feeding on rather rare host plant species. Analogous webs including specialized herbivores on tropical vegetation, such as miners, are attacked by much more generalized parasitoids, while here we are confronted with an interesting situation of a rare parasitoid attacking rare herbivore on a rare plant species. Further, Chapter 3 brings rather surprising evidence that species diversity of gall makers does not respond to succession trends in tropical forests so that secondary and primary forests have comparable numbers of galling species. This is in contrast with the situation in ants, as shown during the PhD defense by Petr Klimes some time ago, and in miners, as will be shown during PhD defense by Ondrej Kaman at some point of time in the future.

In summary, Philip Butterill has combined remarkable taxonomic, field and analytical skills to produce novel, interesting and in many aspects surprising results that are in many respects laying foundational information on quantitative food webs for gall makers in the tropics. It is therefore my opinion that he has demonstrated his ability as an independent researcher and a clear potential to lead a high quality research program of his own in the future. That is why he should be awarded a PhD degree by the University of South Bohemia.



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