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How to inventory tropical flies (Diptera)—One of the megadiverse orders of insects

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Abstract

A new approach to inventory Diptera species in tropical habitats is described. A 150 x 266 m patch of cloud forest at Zurquí de Moravia, Costa Rica (10.047N, 84.008W) at 1585 meters asl was sampled with two Malaise traps for slightly more than one year (Sept. 12, 2012–Oct. 18, 2013). Further concomitant sampling with a variety of trapping methods for three days every month and collecting during a one-week intensive "Diptera Blitz", with 19 collaborators collecting on-site, provided diverse additional samples used in the inventory. Two other Costa Rican sites at Tapantí National Park (9.720N, 83.774W, 1600 m) and Las Alturas (8.951N, 82.834W, 1540 m), 40 and 180 km southeast from Zurquí de Moravia, respectively, were each sampled with a single Malaise trap to allow for beta-diversity assessments. Tapantí National Park was sampled from Oct. 28, 2012–Oct. 13, 2013 and Las Alturas from Oct. 13, 2012–Oct. 13, 2013. A worldwide group of 54 expert systematists are identifying to species level all 72 dipteran families present in the trap samples. Five local technicians sampled and prepared material to the highest curatorial standards, ensuring that collaborator efforts were focused on species identification. This project, currently in its final, third year of operation (to end Sept. 1, 2015), has already recorded 2,348 species and with many more yet expected. Unlike previous All Taxon Biodiversity Inventories, this project has attainable goals and will provide the first complete estimate of species richness for one of the four megadiverse insect orders in a tropical region.

Considering that this is the first complete survey of one of the largest orders of insects within any tropical region of the planet, there is clearly great need for a consistent and feasible protocol for sampling the smaller but markedly more diverse smaller insects in such ecosystems. By weight of their species diversity and remarkable divergence of habit, the Diptera are an excellent model to gauge microhabitat diversity within such systems. Our model appears to be the first to provide a protocol that can realistically be expected to provide a portrayal of the true species diversity of a megadiverse order of insects in the tropics.

Key words: Biodiversity, diversity, tropical, Costa Rica, ATBI, Diptera

Introduction

One of the great gaps in our understanding of biodiversity is our current inability to accurately estimate the number of species of smaller terrestrial invertebrates, particularly in tropical regions where the full species richness of insects is still largely a matter of conjecture. With continuing and increasing pressures on ecosystems due to habitat destruction and global climate change, the importance of understanding biodiversity has become paramount. As pointed out by Terry Erwin (2004), "Considering potential benefits for humanity, not accomplishing an inventory of life on Earth has been the greatest failing of the human race thus far." And as famously noted by Edward O. Wilson (1992) over 20 years ago, we know how many stars are in the Milky Way and the mass of an electron but don't know within an order of magnitude the number of species on our planet. This level of ignorance continues in large measure today and reflects how little we understand, in particular, about the truly megadiverse orders of insects, the beetles (Coleoptera), the butterflies and moths (Lepidoptera), the ants, bees and wasps (Hymenoptera),

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Regardless, our sampling program is an important first step towards understanding how diverse the Diptera might be in the tropics and therefore what precious biological wealth is present among the smaller organisms found there. In a time when every major ecosystem on our planet is under duress, understanding such biodiversity can assist in making conscientious choices regarding both our own and the planet's future.

Finally, it is worth pointing out that in large measure, systematists have been hampered for decades by a lack of funding for research describing the biodiversity of life on our planet. Understanding this diversity should (and could) be a cornerstone in our toolbox of methods to gauge the health and future of our planet, to say nothing of the added benefits of describing millions of more species with their presently unknown characteristics and various roles in ecosystem services. This is not due to a lack of money but rather a question of priorities. The recently heralded Rosetta Mission, successfully sending a probe to Comet 67P, was launched on March 2, 2004 at a cost of about €1 billion ($1.25 billion US). We also think the probe is important as a means of exploring our universe but with a comparable amount of funding systematists could describe much of the fauna and flora on our planet and provide powerful tools to assess what is happening to life on earth. It would be money well spent!

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