Moths cloaked in color

August 31 2009

Erbessa albilinea is a new species of diurnal moth from Costa Rica that feeds as larvae on melastome plants. Credit: James Miller

Travelers to the neotropics -- the tropical lands of the Americas -- might be forgiven for thinking that all of the colorful insects flittering over sunny puddles or among dense forest understory are butterflies. In fact, many are not. Some are moths that have reinvented themselves as butterflies, converging on the daytime niche typically dominated by their less hairy relatives. Now, a new revision of the taxonomic relationships among one such group of insects, the subfamily Dioptinae, sheds light on the diversity of tropical moth species and presents a unique story of parallel evolution.

"These diurnal moths are a microcosm of butterfly evolution," says James Miller, author of the new *Bulletin of the American Museum of Natural History* and a research associate in the Division of Invertebrate

Zoology at the Museum. "There are about 500 spectacular dioptine species, all of which evolved from a common ancestor—a nondescript brown nocturnal moth—into a diversity of butterfly mimics." Miller qualifies this with a technicality, though, noting that no one is sure whether butterflies or diurnal moths evolved their colors first (and who is really mimicking whom).

The wing pattern diversity within the subfamily is enormous: some species mimic clear-winged butterflies and inhabit the darker parts of the forest understory where their co-mimics fly. The caterpillars of these species feed on palms. Still others have wings that are colored blue and yellow and feed on melastomes. About 100 species feed on *Passiflora*, the poisonous passion flowers famous for being consumed by the caterpillars of *Heliconious* butterflies. In fact, although most of the Dioptinae are diurnal, or fly during the day, a few species like those in *Xenomigia* have re-conquered the night. Although most dioptines are neotropical, ranging from lowland jungles to cloud forests at 4,000 meters in the Andes, *Phryganidia californica* occurs in the western United States.

Phaeochlaena hazara belongs in the “tiger strip’ mimicry complex and is widely distributed in the Amazon. Credit: James Miller

The Dioptinae were first recognized as a distinct insect group in 1862 by Francis Walker of the British Museum of Natural History. At the same time, they were pivotal to the writings of Henry Walter Bates after he returned from a decade of exploration and collecting in the Amazon. Bates described moths that fly with and obtain protection from similarly-colored but poisonous butterflies that derive their toxicity from the plants their caterpillars feed on. This system—whereby a harmless species gains protection from its resemblance to a toxic species—is now known as Batesian mimicry.

Miller's new revision of the Dioptinae is the first systematic look at this group in almost a century. After studying over 16,700 specimens housed at 38 different institutions and private collections around the world, Miller discovered and described 64 new species and seven new genera, bringing the total to 456 species in 43 genera. Some of the new species were found during field work in parts of the tropical Americas poorly explored by lepidopterists: *Xenomigia pinasi* from Río Chalpi Grande, Ecuador; *Erbessa albilinea* and *Getta tica* from Braulio Carrillo, Costa Rica; *Phintia broweri* from Tambopata, Peru, and *Erbessa lamasi* from the remote Cosñipata Valley of southeastern Peru. Even so, there is much more work to be done on the Dioptinae. Miller estimates that there are about 100 to 150 species in collections that still need to be described and inserted into the taxonomy, and he thinks that additional fieldwork in under-sampled countries like Bolivia and Colombia will ultimately bring the total number of species to between 700 and 800.

Miller's first step in shedding light on the Dioptinae was to develop an evolutionary tree, or phylogeny. This tree is based on adult morphology of the moths: using 305 characters among 115 of the species (representing all 43 genera), Miller determined that the group was divided into two tribes, Josiini and Dioptini. The first contains the *Passiflora*-feeders, while the second includes species with a remarkable range of host plants. It is interesting that in an age dominated by DNA

analysis, adult morphological traits provided the structure for a very solid phylogeny for this group of animals.

Dioptis uniguttata occurs at a higher altitude that is typical for its genus and is endemic to northeastern Ecuador and Colombia. Credit: James Miller

Other taxonomic changes were also found. The previous classification, published in 1930, had little structure; species whose wing patterns essentially looked the same were lumped together. Miller's careful analysis has dissected these taxonomic groups, finding that 47 of the previously named species could be included within another existing species. Consequently, the total number of species has not increased substantially since the previous systematic review. Miller also found that clear-winged moths evolved four times within the Dioptinae and belong in four different genera. Similarly, moths from the passion-flower feeding group that have orange or yellow stripes radiating from the wing base had previously been put into one genus but are now determined to represent two separate evolutionary events; they belong in two different genera, *Josia* and *Lyces*.

"This *Bulletin* takes a previously unknown but vastly interesting group of insects and provides a means to identify them," says Miller. "Now, there

is a real classification for this group, a sort-of launching pad for future investigations into a broad range of evolutionary topics."

All taxonomic information collected from this research has been placed in the Discover Life database and is currently being entered into the Lepidoptera Tree of Life. This research was funded in part by the National Science Foundation, the American Museum of Natural History, and by Museum trustee Robert G. Goelet. The author also acknowledges the support of the Museum's Lee Herman, David Grimaldi, Toby Schuh, and Steve Thurston, among many others. The Museum is one of the world's foremost venues for publishing large scientific monographs like Miller's *Bulletin*.

Source: American Museum of Natural History

Citation: Moths cloaked in color (2009, August 31) retrieved 26 April 2024 from https://phys.org/news/2009-08-moths-cloaked.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.