A survey of the moth flies (Diptera: Psychodidae) of Thailand, with an emphasis on the fauna of Khao Yai National Park

Complete Report

PROJECT LEADER:
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EXECUTIVE SUMMARY:
Specimens of Psychodidae were collected from Khao Yai National Park (KYNP) between 12 and 18 September, 2009. Most species collected are new to science, while some have previously been collected in Thailand. A checklist of species collected in KYNP is included with this report. Few specimens collected during this project have been destroyed for the purpose of DNA analysis. Most of the remaining specimens are now mounted on microscope slides. Taxonomic work involved in this project will likely continue for several years due to the fact that there are many new genera and species to be described. Type and/or voucher specimens, as well as copies of publications resulting from this work have been or will be returned to Thailand as soon as possible.

ACKNOWLEDGMENTS:
We wish to express our sincere gratitude to the Department of National Parks and the National Research Council of Thailand for granting permission to collect insect specimens from Khao Yai National Park. The Project Leader is especially thankful to NRCT for their help with obtaining the research permit and non-immigrant visa, and to the Forest Insect Team (DNP Forest Entomology and Microbiology Group) for their kind hospitality during his stay in Thailand. We also thank Mr. Manoch Ganpanakngan and all Khao Yai National Park staff for accommodations and assistance during our stay at Khao Yai National Park.

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BACKGROUND AND RATIONALE:

Background
Psychodidae (moth flies and sand flies), with more than 3500 described species, are among the most morphologically and ecologically diverse families of Diptera. Most existing classifications of Psychodidae recognize six subfamilies: Phlebotominae, Bruchomyiinae, Sycoracinae, Trichomyiinae, Horaiellinae and Psychodinae; however, classification of the family remains a work in progress. Psychodids are known to occur in habitats ranging from restroom drains and sewage treatment filters to pristine forests and streams. Due to their frequent abundance in these habitats, moth flies play an important role in the cycling of nutrients. Furthermore, certain psychodid species in the subfamily Phlebotominae are important vectors of *Leishmania* species, which cause Leishmaniasis in humans. Thailand is currently the only country in the world where all subfamilies of Psychodidae are known to occur (Apiwathnasorn et al. 1989; Curler et al. 2006; Curler & Courtney 2009; Curler 2009; Curler, unpublished), yet little is known about the Thai psychodid fauna overall. Due to these facts, Thailand is an excellent country in which to collect and study Psychodidae.

Research overview
This research focuses on systematics of Psychodidae using both morphological and molecular techniques. Morphological studies involve describing new genera and species of Psychodidae from Thailand, as well as developing an inventory of the Psychodidae collected in Thailand. Molecular studies involve developing phylogenetic hypotheses of the relationships of subfamilies and lower rankings within Psychodidae.

Pertinence of research
Research and medical professionals, and the general public often encounter psychodids, yet few people are able to accurately identify these flies. This is mainly because little attention has recently been given to the systematics of this important family, and thus, revisionary studies are badly needed. G. R. Curler’s research is aimed at clarifying the taxonomic groupings within Psychodidae, describing many new psychodid taxa, and facilitating future research on the taxonomy and biology of flies.

Continuing work on the Psychodidae of Thailand
Descriptions of many new genera and species of Thai Psychodidae are either completed or in progress. Keys for identification of Thai Psychodidae are also under construction.

OBJECTIVES OF RESEARCH:

1. To collect additional specimens needed in order to complete ongoing and new morphological and molecular studies of Thai and other Psychodidae.
2. To improve Thai insect collections by depositing type and voucher specimens at various repositories.
3. To strengthen Thai entomology programs by teaching specialized aquatic insect sampling techniques and identification of Psychodidae and other Diptera.
4. To publish species descriptions and phylogenetic studies of Psychodidae.

METHODS:

Scope and location
Sampling will take place in Khao Yai National Park (KYNP) in central Thailand. Specific locations within the park include: "Huai Patabak, 29 km from south entrance of KYNP" (14° 19’N, 101° 21’E, 505m asl.) and "Small creek 6.2 km up Khao Khieo Road" (14° 22’N, 101°24’E, 952m asl.). Additional sampling locations will be chosen based on the presence of suitable psychodid habitat. These locations will include mostly small streams, and areas with standing water.

Collecting strategy and protocols
Approximately 25 larval and 25 pupal specimens of *Horaiella*, and/or *Neotelmatoscopus*, and/or other psychodid taxa will be hand picked from the substrata of streams in Khao Yai. Adult psychodid flies will be collected by hand aspirating, sweep netting, and Centers for Disease Control (CDC) light traps. All specimens will be fixed in 95% ethanol, and some larval specimens will be transferred to 100% ethanol to ensure adequate preservation of DNA.

Reasons and necessity of specimen collection and export
For some rare or uncommonly collected Thai psychodids, only one or two specimens are available for study, making species descriptions tenuous and molecular studies unfeasible; furthermore, most of the Thai specimens currently being studied by the Project Leader were not adequately preserved for molecular analysis. Consequently, additional or fresh specimens of certain taxa (e.g. the genus *Horaiella* Tonnoir) need to be collected before molecular studies and species descriptions can be completed. Specimens were exported to the United States, where specimens were processed, and molecular and morphological studies are completed or ongoing.

Handling of specimens
To facilitate future systematics research in Thailand, the United States and elsewhere, type material and quality specimens of all species (where available) have been and will continue to be deposited in the Forest Insect Collection, Department of National Parks, Bangkok, the United States National Museum of Natural History (Smithsonian Institution), Washington, D.C. and the Natural History Museum of Los Angeles County, Los Angeles, CA. Other Thai depositories of voucher material include (1) Entomology Museum, Department of Entomology, Kasetsart University; and (2) Queen Sirikit Botanical Gardens Insect Collection, Chiang Mai.

RESEARCH RESULTS:

Specimens collected
Larvae and pupae of *Horaiella iota* Curler were unfortunately not found, but a single adult female specimen was collected and preserved in 100% EtOH for DNA extraction. It is not clear where the immature stages of *H. iota* occur, as they are not located in the
same habitat type as their congeners. Aside from *Horaiella*, many specimens of several new species in genera including *Neotelmatoscopus* Tonnoir and *Gondwanoscurus* Jezek were collected.

****Some psychodid species in subfamily Phlebotominae are of medical and veterinary importance because they feed on vertebrate blood, and are known to transmit disease organisms among their hosts. A number of phlebotomine psychodids were collected in KYNP, including some species that are new records for Thailand and others that are new to science. Please see the checklist of species for detailed information.

**Printed products**
The following articles have been or will be submitted for publication within the next year (copies of article in print are provided):


Curler, G.R., J. Phasuk and W. Sakchoowong, New species of *Neotelmatoscopus* and a redescription of *N. indicus* (Feuerborn) from Thailand. To be submitted to *Zootaxa*.

Curler, G.R., New species of *Gondwanoscurus* Jezek from Thailand. To be submitted to *Zootaxa*.

Additional publications will certainly result from this work, but it is not possible at this time to determine when they will be ready for submission.

**Identification keys**
An internet-based, interactive taxonomic key to the subfamilies of Psychodidae, and a key to the psychodid taxa occurring in Thailand are currently being developed using Lucid ® 3.4 software. All Lucid keys will be disseminated via the World Wide Web. In addition to the Lucid keys, Dichotomous keys to the subfamilies and genera of Thai Psychodidae are in preparation. Copies of all keys will be provided to the Thai Department of National Parks and Kasetsart University.

**Educational products**
A graduate student has earned a Ph.D. partly as a result of this work. Thai students and researchers in the Department of National Parks and the Faculty of Agriculture at Kasetsart University, Bangkok have been informed about past and current work on morphological and molecular systematics of Psychodidae, and have received some training about techniques used to sample Psychodidae and other aquatic insects.
CONCLUSIONS AND RECOMMENDATIONS:
Significant advances in our knowledge of Thai Psychodidae have occurred within the past five years, but much work on Thai and other Psychodidae remains to be completed. By collecting a specimen of *Horaiella* for DNA extraction, we now have a complete data set for phylogenetic analysis of all psychodid subfamilies. This is an unprecedented study, which would not have been possible without conducting fieldwork in Thailand. For this and other reasons, the current project was a success.

A continuing search for the immature stages of *Horaiella* and other Thai psychodids would be a worthy endeavor for Thai and/or foreign researchers. Thailand is one of the few countries in the world where rare taxa such as *Horaiella* are known to occur in protected habitats, and thus it provides a unique opportunity to study them for many years to come. It would also be worthwhile for Thailand to strengthen its knowledge base for aquatic entomology—particularly for aquatic Diptera. There are many aquatic entomologists in Thailand, but few have experience with collecting specialized taxa such as Diptera.

***A complete survey of Phlebotomine sand flies should be conducted in Khao Yai National Park and other parks in Thailand. We currently know very little about phlebotomine species that occur in Thailand, despite the fact that some cases of Leishmaniasis have been identified in the country. Many undescribed and medically important phlebotomine species are likely to be found, and it is strongly advised that DNP be aware of vector fly species that occur within park boundaries.***

REFERENCES:


