SURVEYS FOR NATURAL HOST PLANTS OF *MANSONIA* MOSQUITOES INHABITING TOH DAENG PEAT SWAMP FOREST, NARATHIWAT PROVINCE, THAILAND

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Abstract. Surveys were carried out monthly from April-October 2002 to examine 68 sampling sites around "Toh Daeng" peat swamp forest in Narathiwat Province, Thailand, of which 38 were known *Mansonia*-positive habitats and 30 were *Mansonia*-negative sites. The present larval surveys were qualitative owing to features of the host plants (location, distribution, and abundance), difficulties in locating and selecting the host plants in the swamp forest, and time constraints. Twenty attempts were made for each species for larvae. The presence of *Mansonia* larvae on each plant species was confirmed 6 times for each plant and location. Larvae of *Ma. bonneae* and *Ma. uniformis* were obtained from 18 plant species (10 families) : *Metroxylon sagu, Melaleuca cajuputi, Pandanus militaris, Pandanus immerses, Hanguana malayana, Typha angustifolia, Hymenachne acutigluma, Scirpodendron ghaeri, Scleria sumatrensis, Rhynchospora corymnosa, Sacclolepis indica, Cyperus babakan, Cyperus corymbosus, Lepironia articulata, Leersia hexandra, Eichhornia crassipes, Pistia stratriotes* and ferns. The emergent grasses, *S. ghaeri, S. sumatrensis, H. acutigluma, R. corymnosa, S. indica, C. babakan, C. corymbosus,* and *L. articulata,* were the preferred host plants. Samples from larger trees, *M. sagu* and *M. cajuputi*, yielded low numbers of 1-7 larvae per scraping. *Ma. uniformis* was recovered from most of the host plants, while *Ma. bonneae* preferred submerged plants and was not found on the floating aquatic plants, *E. crassipes* and *P. stratriotes.* The description of modified dipper and dipping techniques are given and discussed.

INTRODUCTION

Wharton (1962) published a detailed study of the biology of *Mansonia* mosquitoes in relation to filariasis in Malaysia. He reported that *Ma. annulata* and *Ma. bonneae* bred in dense swamp forests where larvae attached to the pneumatophores of trees, while *Ma. indiana* and *Ma. uniformis* inhabited open swamp forest where the immature stages attached to the roots of floating aquatic plants, such as water lettuce (*Pistia stratriotes*) and water hyacinths (*Eichhornia crassipes*). Reports regarding the peat swamp forest area as a breeding place for *Mansonia* mosquitoes are few (Wharton 1962; Chiang, 1993; Krishnamoorthy *et al,* 1994). Harinasuta *et al* (1971) conducted a brief bionomics study of *Mansonia* mosquitoes in Chumphon Province, southern Thailand. They investigated their biting habits, host preferences, and breeding places, mainly in the open swamps. The study on the immature stages of *Mansonia* mosquitoes inhabiting swamp forest in relation to host plants has not yet been attempted in Thailand. This is partly due to difficulties in sampling techniques and identifying immature *Mansonia*, and accessibility to peat swamp forests. The present study attempted to identify where *Mansonia* larvae are concentrated and to determine whether there is a specific preference for the host plants.

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MATERIALS AND METHODS

Peat swamp forest is comprised of big trees

and emergent plants with root systems anchored to the bottom, where water depth ranges from 0.5-5.0 m. A survey of the prevalence of host plants for *Mansonia* mosquitoes was carried out around peat swamp forest using dippers modified from the device described by Batzer (1993). The sampling equipment was designed to be very strong and long enough to reach plant roots in virtually all cases. The bottom-screened dipper is 25.0 cm in diameter with a 10-cm stainless rim welded onto a handle made from a 2-m long of 2.5-cm metal pipe. The mesh screen size is 1.0 mm.

Prior to larval collections, a list of plant species in the peat swamp forest, "Phru Toh Daeng", was checked (Phlengklai *et al*, 1991) to identify potential host plants naturally growing in the study area. It was assumed that mosquitoes were adapted to almost every conceivable type of aquatic vegetation. Larval dipping took place randomly in larval sampling stations during the day time, each day of the field visit (April-October, 2002). There was no limit to the sampling sites and numbers of larval surveyed in order to obtain as many specimens as possible. All plants that were abundant in the swamp forest, either floating plants (*Eichhornia crassipes, Pistia stratriotes*), submerged plants (grasses and ferns), or standing big trees (sago and cajeput), were sampled. At least five dips per each species of aquatic plants were taken. Whichever plant species was found positive for *Mansonia* larvae, the dipping was repeated six times at different sampling sites to confirm the presence of larvae. The larvae were then collected with an eye-dropper and put in plastic film vials. Date, time, plant name and location of collection were recorded.

To obtain *Mansonia* larvae attached to the roots or stems of trees/emergent plants, the dipper was oriented so that the edge of screen rim was at the base of the plant. The dipper was forcibly pushed against the plant stem and was then scraped up vertically through the plant root mass, along the plant stem to the water surface. Larvae were sorted on-site by backwashing water through the screen until most of the fine sediment was eliminated and the larvae could be seen clearly. The collected larvae were then killed in hot water, preserved in 90% alcohol, and mounted on clean slides using Hoyer's medium as described by Rattanarithikul (1982). All larval specimens were identified as to species using the key of Apiwathnasorn *et al* (1991).

Table 1
Collections of *Mansonia* larvae obtained from various host plants inToh Daeng peat swamp forest, Narathiwat Province.

Plant species	Mosquito species	
	Ma. bonneae	*Ma. uniformis*
Family Palmae		
Metroxylon sagu	+	+
Family Myrtacae		
Melaleuca cajuputi	-	+
Family Pandanaceae		
Pandanus militaris	+	+
Pandanus immerses	-	+
Family Hanguanaceae		
Hanguana malayana	+	-
Family Typhaceae		
Typha angustifolia	-	+
Family Gramineae		
Hymenachne acutigluma	+	+
Family Cyparaceae		
Scirpodendron ghaeri	+	+
Scleria sumatrensis	+	+
Rhynchospora corymnosa	+	+
Sacclolepis indica	+	+
Cyperus babakan	+	+
Cyperus corymbosus	+	+
Lepironia articulata	-	+
Family Gramineae		
Leersia hexandra	-	+
Family Pontederiaceae		
Eichhornia crassipes	-	+
Family Araceae		
Pistia stratriotes	-	+
Ferns	+	+

RESULTS

The surveys were carried out monthly from April-October, 2002. Sixty-eight sampling sites around the peat swamp forest were examined, of which 38 were known *Mansonia*-positive habitats and 30 were *Mansonia*-negative sites. The present larval survey was qualitative due to fea-

tures of the host plants (location, distribution and abundance), difficulties in locating and selecting host plants in the swamp forest, and time constraints. Since submerged plants in the swamp were dense, dips were made on a cluster of each plant species instead of a single plant. Twenty attempts were made to search each host plant species. The presence of *Mansonia* larvae on each plant species was confirmed six times on the same plant in different locations.

Larvae of *Ma. bonneae* and *Ma. uniformis* were obtained from 18 plant species, of which *Scirpodendron ghaeri, Scleria sumatrensis, Hymenachne acutigluma, Rhynchospora corymnosa, Sacclolepis indica, Cyperus babakan, Cyperus corymbosus,* and *Lepironia articulata*, were the common host plants (Table 1). Samples from larger trees, *Metroxylon sagu* and *Melaleuca cajuputi* yielded low numbers (1-7) of larvae per scraping. *Ma. uniformis* was recovered from most of the host plants, while *Ma. bonneae* preferred submerged plants and was not collected from the floating aquatic plants, *Eichhornia crassipes* and *Pistia stratriotes.*

DISCUSSION

The characteristics of peat swamp forest, such as vegetation, acid water, and wild animals, may play an important role in favoring production of the two main *Mansonia* species. The peat swamp forest is comprised mainly of big trees and emergent plants with their root systems anchored to the bottom. During the wet season (September-December), monthly rainfall exceeds 600 mm, compared to 50 mm in the dry period (February-April). Continuous rainfall throughout the year ensures that the peat swamp forest has a constantly high water table, supporting populations of the host plants preferred by *Mansonia* spp. In addition, *Ma. bonneae* and *Ma. annulata* may have a strong affinity for acidic water conditions and thus be restricted to the areas of peat swamp forest in southernmost Thailand. Breeding habitats are plentiful in places close to hosts (villages and swamp forest). In this study, it was found that *Mansonia* mosquitoes inhabiting peat swamp forest were able to choose their breeding places from a variety of trees and plants. The relationship of host plants and immature stages of *Mansonia* species is likely to be site specific rather than plant species specific, since *Ma. bonneae* and *Ma. uniformis* were both found on the same host plant species but in different locations. *Ma. bonneae* was commonly collected from plants grown in the peat swamp forest while *Ma. uniformis* was collected from swamps at the periphery with a more open environment. This finding suggests that local distribution can result from factors affecting adult mosquitoes rather than larvae.

A variety of submerged plants ranging from grasses and sedges (*L. articulata*) to big trees (*M. cajuputi* and *M. sagu*), were found to be suitable hosts for immature *Mansonia*. Most of the host plants for *Mansonia* larvae found in the present study were newly recorded as hosts, namely *M. sagu, M. cajuputi, P. militaris, P. immerses, H. malayana, T. angustifolia, S. ghaeri, S. sumatrensis, H. acutigluma, R. corymnosa, S. indica, C. babakan, C. corymbosus, L. articulata* and *L. hexandra.* Since the modified dipper used could pick up only small numbers of *Mansonia* larvae, dipping techniques and newly designed dippers are needed for further study to yield quantified data suitable for statistical analyses.

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