J. Aquat. Plant Manage. 44: 142-144

Host Plant Preference of *Mansonia* Mosquitoes

GOUTAM CHANDRA[1], A. GHOSH, D. BISWAS[1] AND S. N. CHATTERJEE[1]

INTRODUCTION

Human brugian filariasis, which is caused by *Brugia malayi* and *B. timori*, affects 13 million people in the oriental region (WHO 2002) and is most common in India and China (Ottesen *et al.* 1997). The most important vectors of *B. malayi*, in the endemic countries of South-east Asia, are different *Mansonia* species in the subgenus *Mansonioides*. The vectors of the parasite causing brugian filariasis in the Western Pacific and South-east Asian regions were reviewed by Chow in 1973 and Ramaliangam in 1975, while *Ma. annulifera* was reported by Iyengar in 1938, as an agent for transmission of *B. malayi* in Travancore, India.

It has been observed that many species of mosquitoes, particularly under subgenus *Mansonioides* prefer habitats with well-developed beds of submerged, floating-leaf or emergent aquatic macrophytes because the vegetated regions protect them from physical disturbances and provide mechanical support and favorable conditions for oviposition. Unlike other mosquitoes, the larvae and pupae of *Mansonia* must attach their breathing tubes to the underwater roots, stems, or leaves of floating aquatic plants if they are to survive (Rajendran et al. 1989). Removal of such plants via mechanical, biological, or chemical control would therefore effectively prevent development of *Mansonia*.

Control of brugian filariasis in most endemic countries has been limited to the use of chemo-therapy, either on the basis of an individual's filarial symptoms or as mass drug administrations. The objective of the Global Programme to Eliminate Lymphatic Filariasis (GPELF) is to break the transmission cycle between the mosquito vectors and human hosts. Thus knowledge on the distribution of mosquito species, their biology, habitats and control agents (mechanical, biological and chemical) is essential to develop integrated control methods against these insects. Although there have been a few relevant field studies and vector-control trials (Rajendran et al. 1993, Chang 2002, Ferreira et al. 2003), there have hardly been any operational-scale interventions against the vectors of *B. malayi* and *B. timori*. The objectives of the present study were to observe the host plant preference of different species of *Mansonia* mosquitoes during oviposition and to determine if the aquatic macrophyte species influences the survival of *Mansonia* larvae under laboratory conditions.

MATERIALS AND METHODS

The present study was conducted at Burdwan (23°16'N, 87°54'E), West Bengal, India, during June 2004. Larvae of *Mansonioides* were obtained from a laboratory colony maintained in the Mosquito Research Unit, Department of. Zoology, The University of Burdwan. The colony was maintained at 25 to 30°C, a pH of 6.95 to 7.03 and dissolved oxygen from 5.5 to 6.1 mg/l in the laboratory and was kept free from exposure to pathogens, insecticides, or repellents. Mosquito larvae were fed on a fine-ground dog biscuit. The adult colony was provided with 10% sucrose and 10% multivitamin syrup, and was periodically blood-fed on restrained rats.

During the lab based experiment, pond water (500 ml) was placed in each of 5 enamel bowls (bowl No. 1-5). Pond water was sieved through a net (>500 mesh) to exclude larvae of other insects, phytoplankton and zooplankton before conducting the experiments. The water fluctuated between 26 to 31°C, a pH of 6.34 to 6.61 and dissolved oxygen 5.28 to 6.47 mg/l, during the entire period of experimentation. The aquatic plants *Pistia stratiotes*, *Eichhornia crassipes*, *Azolla pinnata* and *Mimosa pudica* were collected from shallow freshwater ponds and rice fields at Burdwan and placed on the water surface of 1st, 2nd, 3rd and 4th bowls respectively. In the 5th bowl thermocol pieces (as a neutral control medium) were placed instead of plants. All the bowls (ovitraps) were kept in a mosquito cage. Five blood fed gravid individuals of each of the two species of mosquitoes, namely, *Ma. annulifera* and *Ma. indiana* were released in the mosquito cage to determine the host plant preference for oviposition and breeding. All the egg clusters obtained from each ovitrap were collectively counted (without separating the egg clusters of each species) with a microscope and recorded after 48 hours. The experiments were repeated for 5 times in five separate days with freshly collected aquatic macrophytes.

Investigations were also made to find out whether the aquatic weeds could influence the survival of larvae of *Ma. annulifera* and *Ma. indiana* under laboratory conditions. Fifty freshly hatched larvae were introduced and reared in each of five different plastic containers (No. 1-5), each containing 3.5 liters of pond water. The pond water used was similar to the quality of insects' habitat and sieved through a net (>500 mesh) to exclude any larvae of other insects. However, the water contained the natural food of larvae such as phytoplanktons and zooplanktons. *P. stratiotes*, *E. crassipes*, *A. pinnata* and *M. pudica* were placed on the water surface of 1st, 2nd, 3rd and 4th containers respectively. In the 5th container thermocol pieces (which contain air that is essential for the survival of *Mansonia* mosquitoes) were placed instead of plants and treated as a control set. Each experiment was repeated five times in five separate days with freshly collected aquatic macrophytes. The larvae were fed every 2nd day with 0.2 g of Yeast powder. Survival of the first instar larvae was recorded in each case until they reach the fourth instar stage. All the data were analyzed statistically by 'one way ANOVA test' (MS EXCEL, 2000).

[1]Mosquito Research Unit, The University of Burdwan, West Bengal, India 713104. Corresponding author e-mail: goutamchandra63@yahoo.co.in.
Received for publication July 15, 2005 and in revised form February 4, 2006.

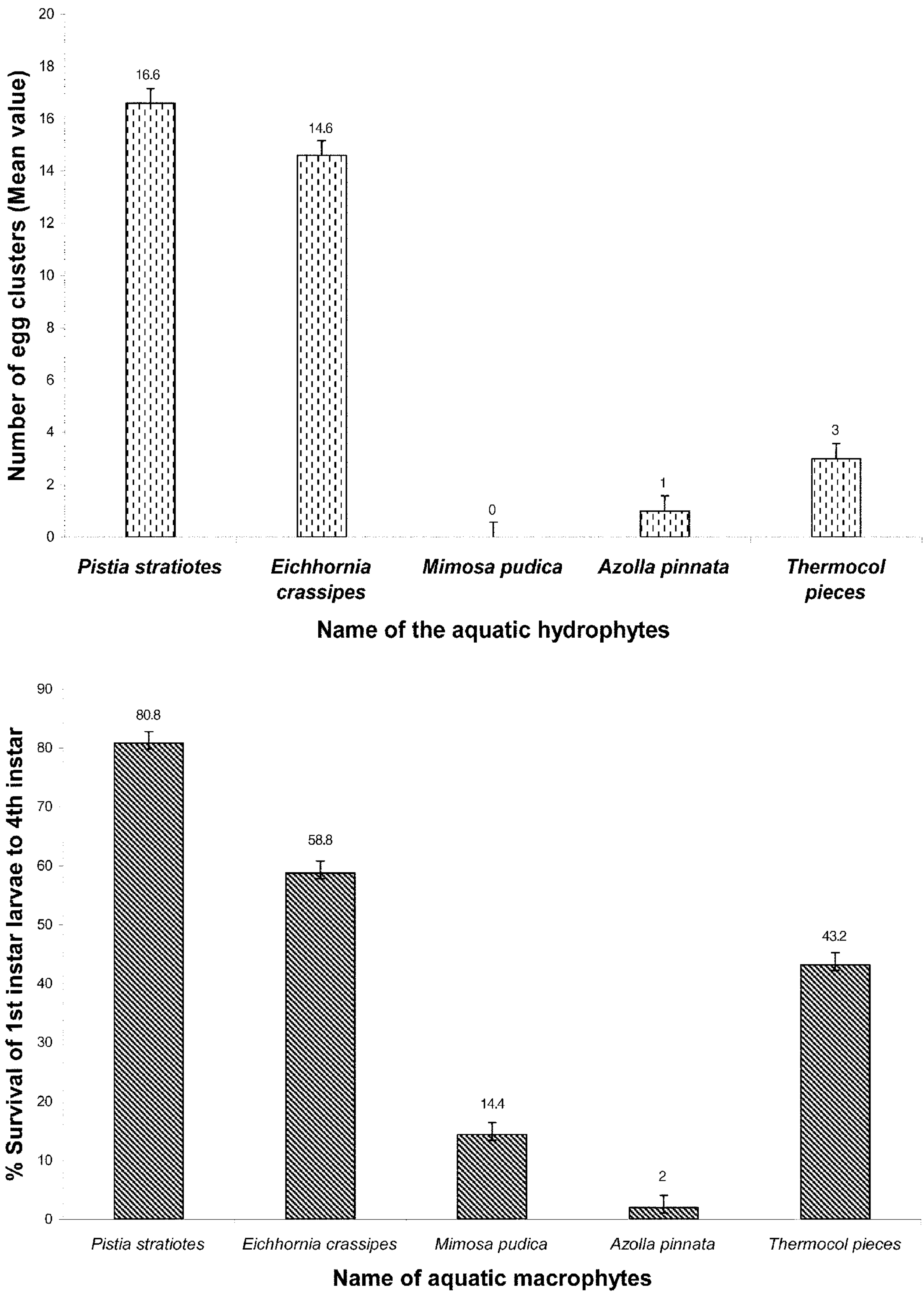

Figure 1. (a) Egg laying preference of *Ma. annulifera* and *Ma. indiana* mosquitoes on different hydrophytes and thermocol pieces in the laboratory (n = 5). (b) Host plant preference of *Ma. annulifera* and *Ma. indiana* larvae and their survival rates (%) under laboratory conditions in the presence of aquatic plants.

RESULTS AND DISCUSSION

A total of 176 egg clusters collectively of *Ma. annulifera* and *Ma. indiana* mosquitoes were obtained in 5 ovitraps containing *P. stratiotes*, *E. crassipes*, *M. pudica*, *A. pinnata* and thermocol pieces (Figure 1a). When oviposition preferences of *Mansonioides* over different aquatic weeds were compared, maximum egg clusters were found to be deposited on the lower lamina of *P. stratiotes* (47.2%) followed by *E. crassipes* (41.5%), thermocol sheets (8.5%) and *A. pinnata* (2.8%). No egg clusters were found in *M. pudica*. When the egg laying preference of *Mansonia* mosquitoes was analyzed statistically using 'ANOVA' test, it was found that the number of egg cluster laid on *P. stratiotes and E. crassipes* was significantly higher ($p < 0.05$) than those of *M. pudica* (p value of 6.0 and 5.9 respectively). However no significant increase in the number of egg clusters was found in *A. pimnata* and thermocol pieces compared to those of *M. pudica* (tabulated value of 'F' = 5.3 at 0.05 level of probability).

The survival rate of larvae was also greatly influenced by different host plants. Out of 5 experiments carried out in plastic containers containing *P. stratiotes*, *E. crassipes*, *M. pudica*, *A. pinnata* and thermocol pieces, maximum number of larvae surviving was in *P. stratiotes* (survival rate 80.8%) followed by *E. crassipes* and *M. pudica* (58.8% and 14.4% respectively) (Figure 1b). Statistical analysis by 'ANOVA' test showed that the larval mortality rate was significantly higher ($p < 0.05$) in *A. pinnata* in comparison to *E. crassipes* ($p = 5.3$), *M. pudica* ($p = 9.2$), *P. stratiotes* ($p = 6.4$) and thermocol pieces ($p = 8.0$) (tabulated value of 'F'= 5.3 at 0.05 level of probability).

Mansonioides can breed only in fresh water containing floating vegetation and *Ma. annulifera* showed a preference to ponds infested with *Pistia stratiotes* than any other weeds (Iyengar 1938, Rajendran et al. 1993). This study confirms that *Mansonia* species had higher rate of oviposition on *P. stratiotes* and *E. crassipes* and the rate of survival of immatures was also high. The mortality rate of *Ma. annulifera* was highest *in A. pinnata*, which might be due to the toxic effect of the plant since it has been reported to be toxic on mosquito larvae (Becking 1978).

The following observations may explain the differences in breeding potential and survival of *Mansonioides* in different aquatic weeds: a) the size of the aerenchyma in *P. stratiotes* and *E. crassipes* is larger than *Mimosa pudica* and *Azolla pinnata*, which could, therefore, hold more oxygen and maintain a greater number of larvae b) the root tissue of *M. pudica* and *A. pinnata* are more rigid which would impede perforation by the larval siphon c) the influence of the structural complexity of *P. stratiotes* and *E. crassipes*, root systems which may reduce the effectiveness of natural predators of mosquito larvae present in the pond and d) *A. pinnata* might have secondary substances that would be noxious or repellent to *Mansonia* larvae.

Compared with most other vector-borne diseases, brugian filariasis is very susceptible to changes in the physical environment. Breeding sites may become rare as swamps are drained and the aquatic host plants are eliminated. Vector-control management should be sensitive to any environmental-development project, particularly that involving water management. An environmental impact assessment should be maintained before the undertaking of any developmental project. Since these mosquitoes have an obligatory association with selective hydrophytes, attention can be focused towards the habitats, which are highly infested with the weeds of choice in their control strategy. Therefore, clearance of weeds like *Pristia stratiotes* and *Eichhornia crassipes* by mechanical, chemical or biological methods or replacing them with non-preferred species such as *Mimosa pudica* or *Azolla pinnata* might drastically reduce the transmission risk of public health disorders like brugian filariasis.

LITERATURE CITED

Burton, G. J. 1959. Studies on the bionomics of mosquito vectors which transmit filariasis in India Attachment of *Mansonia annulifera* and *Mansonia uniformis* larvae to host plant occurring in *Pistia* tanks in Kerala, South India. Indian J Malariol. 12:75-115.

Becking, J. H. 1978. Ecology and Physiological Adaptation of *Anabaena* in the *Azolla Anaebaen* Symbiosis. Eco Bull. 26: 266-281.

Chang, M. S. 2002. Operational issues in the control of the vectors of Brugia. Annals Trop Med Parasit. 96 supp-2: S71-76.

Chow, C. Y. 1973. Filariasis vectors in the Western Pacific Region. Trop. Med. Parasit. 24:404-418.

Ferreira, R. L. M. 2003. Pereira ES, Har NTF and Hamada N, *Mansonia* spp. (Diptera: Culicidae) associated with two species of macrophytes in a Varzea lake, Amazonas, Brazil. Entomotropica 18(1):21-25.

Iyengar, M. O. T. 1938. Studies on the epidemiology of filariasis in Travancore. Indian J. Med. Res. Memories No-30.

Ottesen, E. A., B. O. Duke, M. Karam and K. Behbehani. 1997. Strategies and tools for the control/elimination of lymphatic filariasis. Bull. WHO. 75:491-503.

Rajendran, G., K. Krishnamoorthy, S. Sabesan and K. N. Panicker. 1989. Attachment behaviour of immatures of *Mansonia annulifera* (Theobald). Indian J. Med. Res. 89:192-197.

Rajendran, G., K. Krishnamoorthy, S. Sabesan and K. N. Panicker.1993. Field observations on the host plant selection by *Mansonioides* mosquitoes for oviposition and larval attachment. Trop Biomed. 10:1-4.

Ramalingam, S. 1975. Vectors of *Wuchereria bancrofti* and *Brugia malayi* in the South and Southeast Asian regions: their distribution, biology and control. Ceylon J Med Sci. 24:1-37.

Viswam, K. R. Srinivasan and K. N. Panicker. 1989. Laboratory studies on the host plant preference of *Mansonia annulifera*, the vector of Brugian filariasis. Entomon. 14:183-186.

World Health Organization. 2002. Defining the Roles of Vector control and Xenomonitoring in the Global Programme to Eliminate Lymphatic Filariasis. Report of the Informal consultation held at WHO/HQ, Geneva, 29-31 January 2002. Document WHO/CDS/CPE/PVC.