

Philippine Species of *Mesocyclops* (Crustacea: Copepoda) as a Biological Control Agent of *Aedes aegypti* (Linnaeus)

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Abstract

The predatory capacity of two local populations of *Mesocyclops aspericornis* (Daday) and *Mesocyclops ogunnus* species were evaluated, for the first time in the Philippines, as a biological control agent for *Aedes aegypti* (L) mosquitoes. Under laboratory conditions, *Mesocyclops* attacked the mosquito first instar larvae by the tail, side and head. The mean of first instar larvae consumed by *M. aspericornis* and *M. ogunnus* were 23.96 and 15.00, respectively. An analysis of the variance showed that there was a highly significant difference between the mean number of first instar mosquito larvae consumed by *M. aspericornis* and by *M. ogunnus*, which indicated that the former is a more efficient predator of dengue mosquito larvae.

The results of the small-scale field trials showed that the mean number of surviving larvae in experimental drums was 63.10 and in control drums was 202.95. The Student *t*-test of means indicated that there was a significant difference between the mean number of surviving larvae in the drums with and without *M. aspericornis*. The findings indicated that *M. aspericornis* females were good biological control agents, for they destroyed/consumed about two-thirds of the wild dengue mosquito larvae population.

Keywords: *Mesocyclops aspericornis*, *Mesocyclops ogunnus*, biological control agent, *Aedes aegypti*, *Aedes albopictus*, Philippines.

Introduction

Copepods feed on paramecium (ciliates protozoans) while naupli feed on *Chilomonas* spp. The adult planktonic copepods utilize diatoms as the principal food, while predacious adult copepods feed on protozoa, rotifers and several

aquatic animals of their own size including small fishes and mosquito larvae. Some adults are able to tear pieces out of the body of their victims with their strong mandibles. In the Philippines, around 14 species of Cyclops have been recorded, of which *Mesocyclops aspericornis* and *M. ogunnus* are more common^[1,2].

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In Brazil, a study^[3] reported that under laboratory conditions, four different strains of *M. aspericornis* showed the potential as biological control agents of *Aedes aegypti* larvae. In Viet Nam, under laboratory conditions, *M. aspericornis* consumed a mean 23.75 L1 and killed a mean 13.43 L1, or a total of 37.18 L1 within 24 hours. *M. ogunnus*, on the other hand, consumed a mean 8.48 L1 and killed a mean 7.54 L1 or a total of 16.02 L1 within 24 hours^[4]. In Australia, six species of *Mesocyclops* were evaluated as biological control agents of *Aedes aegypti*^[5]. Of these, *M. aspericornis* was found to be the most effective predator. This study attempted to evaluate, for the first time, the potential of the local population of two species of *Mesocyclops* as biological control agents of *Aedes aegypti* (L) under laboratory and field conditions in the Philippines.

Methodology

Mesocyclops culture

Mesocyclops aspericornis and *M. ogunnus* were raised in laboratory following the techniques adopted by Marten and Thomson^[6]. To ensure the establishment of a single species culture, a female with egg sacs was captured and placed in a petri dish for examination under a dissecting microscope before it was transferred to a wide-mouthed beaker containing 100 ml of mixed culture of *Paramecium caudatum* and *Chilomonas* sp. (food of *Mesocyclops*). Populations of *Chilomonas* sp. and *P. caudatum* in the culture bottle were maintained using sterile wheat seeds. Sample specimens from copepods culture were sent to Maria Holynska, Museum and Institute of Zoology, Warsaw, Poland, for identification.

Laboratory trials

In a 600 ml beaker, 500 ml filtered tap water with pH 7 was poured. Then 50 *Aedes aegypti* L1 obtained from laboratory culture and a female *M. aspericornis* were added at the same time. The same procedure was done for *M. ogunnus*. The control group did not receive *Mesocyclops*. The experiment was replicated six times and was observed every day for five consecutive days, with daily replacements of new L1. The daily number of L1 destroyed or consumed by *M. aspericornis* and *M. ogunnus* and those that died in the control group were determined. Copepods' feeding behaviour was observed.

Field trials

Permission to conduct the study in Estero de Tanque located at P Nieto Street, Barangay 674, Zone 73, Paco, Manila, was secured from the community health officials and Barangay chairperson. Members of the households were informed regarding the procedures to be undertaken and the possible benefit they could derive from it. Consent from the caretakers of the sample households was also secured.

A preliminary study was conducted for 15 days. Twenty houses were chosen as study sites. Two drums per household or a total of 40 drums were emptied and filled almost to the brim with tap water, pH 7.2. A litre of water as sample from each drum container was collected in sterile bottles and brought to the laboratory to exclude the presence of fungi, bacteria and indigenous copepods. Mosquito eggs that hatched into larvae in drums were monitored and collected daily for

recording and identification. Water pH, water temperature and ambient temperature were taken daily. Drums were checked daily for the presence of mosquito eggs and larvae with the aid of a magnifying glass. Drums with mosquito larvae were marked and female copepods were introduced in experimental drums using the ratio one *Mesocyclops aspericornis* per 50 *Aedes aegypti* first instar larvae (L1). No copepods were introduced in the 20 control drums. Observation was made daily for 15 consecutive days. Surviving larvae were collected from all drums and brought to the laboratory for recording and species identification.

Results and discussion

Laboratory trials

The results of the predatory capacity of *M. aspericornis* and *M. ogunnus* as evaluated under laboratory conditions and analysis of variance are presented in Tables 1 and 2. The mean L1 consumed by *M. aspericornis* was 23.96 while that of *M. ogunnus* was 15.00. Control means were 0.63 L1 and 0.60 L1, respectively. The findings showed that there was a highly significant difference between the mean number of *Ae. aegypti* L1 consumed by *M. aspericornis* and that of *M. ogunnus* and the control group.

Table 1. Predatory capacity of female *Mesocyclops aspericornis* vs *Aedes aegypti* first instar larvae in 500 ml filtered water under laboratory conditions

Treatment	Mean	F value	Tabular f	Statistical significance
Experimental group	23.96	338.83	7.12	Highly significant
Control group	0.63			

Table 2. Predatory capacity of female *Mesocyclops ogunnus* vs *Aedes aegypti* first instar larvae in 500 ml filtered water under laboratory conditions

Treatment	Mean	F value	Tabular f	Statistical significance
Experimental group	15.00	319.18	7.12	Highly significant
Control group	0.60			

To determine if there was a difference between the mean number of L1 consumed by *M. aspericornis* and *M. ogunnus*, the analysis of variance was carried out (Table 3). The findings showed that there was a highly significant

difference between the mean number of L1 consumed by *M. aspericornis* and by *M. ogunnus*. The study showed that *M. aspericornis* was a more efficient predator of *Aedes aegypti* larvae.

Table 3. Comparison of the predatory capacity of *M. aspericornis* and *M. ogunnus* under laboratory conditions

Treatment	Mean	F value	Tabular f	Statistical significance
<i>M. aspericornis</i>	23.96	36.11	7.12	Highly significant
<i>M. ogunnus</i>	15.00			

Table 4. Predatory capacity of *Mesocyclops aspericornis* vs *Aedes* larvae in small-scale field trials using drum containers

Treatments	# Replicates	Mean + SD	P value	Statistical significance
Experimental group	20	63.10 + 59.43	0.0002	Significant
Control group	20	202.95 + 140.43		

Field trials

The results of the field trials are presented in Table 4.

The mean L1 in experimental drums was 63.10 and 202.95 L1 in control drums. To determine the difference between the mean number of surviving larvae in the drums with *M. aspericornis* and in the drums without *M. aspericornis*, a Student *t*-test was used. The findings indicated that there was a significant difference between the mean number of surviving larvae in the drums with and without *Mesocyclops*. This significant difference suggests that *M. aspericornis* is a good biological control agent, for it consumed about two-thirds of the wild, dengue mosquito larvae population.

Conclusion

The results of the study showed that *Mesocyclops aspericornis* was an efficient predator of *Aedes aegypti* larvae both in

laboratory and field conditions. These copepods could be effectively used for the control of *Aedes* breeding in non-removable containers, viz. drums and used tyres.

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