

ROLE OF DRAGONFLY (*Brachytron pratense*) NYMPH AS A BIOCONTROL AGENT OF LARVAL MOSQUITOES

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Abstract. The failure of traditional vector control operations through chemical insecticides renewed interest in biological control method. In the present study Dragonfly (*Brachytron pratense*) nymph has been proved to be a strong biocontrol agent of *Anopheles subpictus* larvae in the laboratory condition. Average daily larval feeding rate of *B. pratense* nymph decreased when the search area was increased. Feeding rate increased when prey density was increased. In the field conditions also, *B. pratense* played very effective role as predator of different species of larval mosquitoes.

Keyword: *Brachytron pratense*, nymph, mosquitoes, biocontrol, search area, prey, predator

INTRODUCTION

Anopheles subpictus is a predominant house-frequenting mosquito among the anophelines reported from various parts of the world. It has been reported as a vector of malaria in Australasian zone⁽¹⁾ and also secondary vector in Srilanka⁽²⁾. It has been incriminated as a malarial vector in different parts of India^(3, 4, 5). This mosquito species is very prevalent and act as a primary vector of malaria in Tarakeswar area, West Bengal, India⁽⁷⁾. It is resistant to chemical insecticides in Pakistan, Nepal, Sri Lanka, Indonesia, Bangladesh and also in different parts of India like Delhi state, Punjab and Pondicherry^(8, 9, 10, 11). For these reasons this mosquito species has been selected for laboratory studies during the present piece of work.

Under the alternative strategy of malaria control by means of bio-environmental improvement techniques, primary importance is given to antilarval operations. *B.pratense* nymphs are aquatic in habit, crawl at the bottom of water bodies and often come to water surface. Nymphs capture prey by the modified labium, which is drawn out into a prehensile organ called

the mask. While catching prey, the mask is thrown forward and extended with incredible swiftness and the prey transfixed with the hook is drawn into the mouth cavity. At rest the labium is folded over the jaws but can be extended to collect prey within a fraction of a second. Food preference of Dragonfly nymph includes mosquito larvae and pupae, chironomid larvae, nymphs of their own species, small tadpoles and hatchlings of fishes in laboratory condition⁽¹²⁾. Preying habits of dragonfly nymph have been reported by Pritchard^(13, 14). The present study was carried out to observe the daily feeding rate of *B. pratense* nymph on fourth instar *An. subpictus* larvae and to examine the effect of variations in search area and ratio of predator and prey on larval predation in laboratory conditions. Studies were also conducted to determine the larval feeding efficacy of this predator in field conditions.

MATERIALS AND METHODS

Fourth instar *An. subpictus* larvae were collected from shallow ponds and rice fields of Tarakeswar area of Hooghly district, West Bengal, where this species

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has been incriminated to be the vector of malaria ⁽⁷⁾. In the laboratory, one nymph (4.5 cm in length) of *B. pratense* was allowed to feed on one hundred 4th instar *An. subpictus* larvae for 24 hours in a water bowl containing three litres of pond water. The experiment was conducted three times on three separate days, each with three replications. All the nymphs used in the experiments were freshly collected (unstarved). Number of larvae consumed by *B. pratense* nymph through one day has been noted at an interval of three hours. The experiments were started at 5 a.m. of a day and it was completed at 5 a.m. of the next day to see the average daily larval feeding rate of a nymph. Similarly, 2, 2, and 5 nymphs were allowed to feed on 150, 200 and 500, 4th instar *An. subpictus* larvae, respectively in the similar bowls containing 3 litres of pond water. Then in bowls each containing 18 litres of pond water, 1, 2, 2, and 5 nymphs were allowed to feed on 100, 150, 300 and 500 *An. subpictus* larvae respectively. Three replicates were done for each experiment. Average daily feeding rate in each case was determined. Effects of variations in search area and variations in predator as well as prey density were analyzed statistically with regression equation.

With the view to examine the efficacy of those Dragon fly nymphs in field condition, Kalna and Burdwan were selected as the study area in the District of Burdwan, West Bengal, India. In both the study areas, 10 cemented tanks (which were made in open air) were selected, with the capacity of holding approximately 300 liters of water. These tanks are usually used in the processing of paddy. The tanks remain unused for a long time in each year, i.e. from post rainy season to early spring, and play the role of natural breeding places of mosquitoes. Before the onset of the experiments netting of the contained water

of those cemented tanks was done with a fine net which allowed the passage of mosquito larvae but excluded larvae or nymphs of larvivorous insects or larvivorous fishes if any. After that netting was done weekly in the same way. Those tanks contained mosquito larvae of different species namely *Culex quinquefasciatus*, *Cx. vishnui* group, *An. subpictus*, *An. vagus*, *An. barbirostris* and *An. annularis*. Larval density per dip (250 ml dipper) of each of 10 tanks was assessed by dipping method ⁽¹⁵⁾. During the assessment of larval density mean of 4 weeks collection was taken which ruled out the probability of increase in larval density through oviposition and hatching of larvae and decrease in larval density through adult emergence. Freshly collected ten nymphs of *B. pratense* were introduced in 5 tanks (from tank No. 1 to 5). No nymph was released in tank No. 6 to 10, which were kept as control. Larval densities in all the tanks were assessed after 15 days from the introduction of Dragon fly nymphs and on the same day nymphs were removed. Densities were assessed again after 15 days from the withdrawal of nymphs from the tanks. Data were analyzed statistically. The experiments (both in laboratory and in the field) were conducted in the months of October and November in 2004.

RESULTS

During 24 hours period a nymph of *B. pratense* consumed an average of 66 fourth instar *An. subpictus* larvae released in a water bowl containing 3 litres of water. Average larval consumption by *B. pratense* nymph at different hours has been presented in Table 1. Out of 66 larvae consumed through 24 hours, it consumed 47 larvae during daylight and 19 larvae during night. Consumption rate during daylight was significantly higher ($p < 0.05$) than that

Table 1. Average larval consumption of fourth instar larvae of *Anopheles subpictus* throughout 24 hours by *Brachyton pretense* nymph (where n=9)

Larva species	Number of larvae consumed between								TOTAL
	5 a.m. & 8 a.m.	8 a.m. & 11 a.m.	11 a.m. & 2 p.m.	2 p.m. & 5 p.m.	5 p.m. & 8 p.m.	8 p.m. & 11 p.m.	11 p.m. & 2 a.m.	2 a.m. & 5 a.m.	
<i>Anopheles subpictus</i>	5	12	19	11	9	5	2	3	66
	±0.4082	±0.8165	±0.6455	±0.7071	±0.7638	±0.7454	±0.3423	±0.5528	±1.6645

at night ($t = 2.1475$). The average daily feeding rate of *B. pratense* nymph on mosquito larvae in relation to variations in the search area as well as variations in predator : prey ratio has been depicted in Table 2.

From the regression equation it was observed that the feeding rate of the predator decreased when the volume of water i.e. search area was increased. On the other hand, feeding rate increased with the increase in the number of predator in a fixed search area. Feeding rate also increased when the density of larvae (prey) was increased.

Results of predatory efficacy of *B. pratense* nymph on mosquito larvae in the field condition showed in the treated tanks mean density of mixed population of mosquito larvae per dip reduced significantly ($p < 0.05$) after 15 days from the introduction of *B. pratense* nymphs both in Kalna and Burdwan but in the control tanks where no nymph was introduced, mean larval density did not differ significantly ($P > 0.05$).

Again mean larval density increased significantly in tanks (from 1 to 5) after 15 days from the removal of nymphs. Tank No. 6 to 10 (control) did not show any significant difference in per dip density in both the areas.

DISCUSSION

Average daily feeding rate on 4th instar *An. subpictus* larvae (66) was very high and it was higher than larvivorous fish like *Gambusia affinis* and *Lebistes reticulatus* ⁽⁶⁾. Feeding rate increased with increased predator density due probably to intra-specific competition. From the results it is apparent that mosquito larvae are very favourite food of dragon fly nymph, which complies with the observation, presented in the short report of Hati and Ghosh ⁽¹²⁾.

Species of larvae found in the tanks were *An. subpictus*, *An. vagus*, *An. annularis*, *Cx. quinquefasciatus* and *Cx. vishnui* group. Reduction of mosquito larvae in their natural breeding sites (in tanks) after the introduction of nymphs is obvious. Insignificant difference in larval density in the control tanks during the period of experiment rules out the possibility of influence/effect of other factors and confirms the role of predator in decreasing the larval density in treated tanks. So, it is very encouraging to use this tool as a good biocontrol agent in the field. The food habit of nymphs change with advancement of age and when they are advanced in age they are particularly addicted to culicid larvae and nymphs of their own and other species of Odonata ⁽¹⁴⁾.

Table 2 Average daily feeding rate of *B. pratense* nymph on fourth stage *A.subpictus* larvae [Where, n=9 in each case]

Average daily feeding rate (x_1)	Standard error of mean	Water volume (litre) (x_2)	No.of larvae given in bowl (x_3)	No.of.nymphs given in the bowl(x_4)
74	2.03	18	500	5
59	3.12	18	300	5
56	5.55	18	150	2
51	4.89	18	100	1
88	2.74	03	500	5
69	3.57	03	200	2
69	5.38	03	150	2
66	4.50	03	100	1

Statistical analysis:

X_1 = Average daily feeding rate

X_2 = Size of the bowl

X_3 = Number of larvae given in the bowl

X_4 = Number of nymphs given in the bowl

From the observation the regression equation turns out to be:

$$X_1 = 62.733311 - 0.87677 X_2 + 0.072089 X_3 - 1.74973 X_4$$

$$r^2 = 1.612$$

Similarly, during the present study the small sized nymphs were not interested to prey upon 4th instar mosquito larvae in laboratory but on starvation they consumed early instar larvae of mosquito. Advanced nymphs (unstarved) readily preyed upon mosquito larvae but they were more active during daylight than night. The life cycle of Dragonflies is very long and the nymphal stage may last for one year or more consisting of 10-15 nymphal instars between egg and imago ⁽¹⁶⁾. So their presence is not seasonal. As the span of nymphal stage is wide and the daily mosquito larval feeding rate is quite high, it can contribute remarkably in reducing mos-

quito population and thereby reduce mosquito borne diseases.

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