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ORIGINAL ARTICLE

An Investigation on Larvicidal Efficacy of some Indigenous Fish Species of Assam, India

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ABSTRACT
Three indigenous fish species of Assam viz., Channa gachua, Puntius sophore and Trichogaster fasciata were documented as larvivorous fish. Experiments were conducted in both day and night with a time period of 12h and 24h respectively. Out of these three species, C. gachua was found to consume a maximum number of mosquito larvae (179±21.21/hr) followed by P. sophore and T. fasciata with a maximum of 66.33±1.52 and 45.67±0.58 respectively. It was also observed that all the fish species consumed maximum numbers of mosquito larvae at first 30 minutes and thereafter the feeding intensity decreased.
***KEY WORDS**: indigenous, larvivorous fish, mosquito larvae, feeding intensity*

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INTRODUCTION
Mosquitoes are known vectors for transmission of disease throughout the world, including the pathogens responsible for encephalitis, equine infectious anaemia, malaria, yellow fever, dengue and filariasis [1,2,3,4,5,6].In order to control mosquito, mainly chemical and biological approaches are employed. Environmental protection agencies have banned or placed severe restrictions on the use of many pesticides, which were formerly used in mosquito control programmes, and there are now fewer adulticides available than there have been for the last 20 year [7].
The biological control of mosquitoes and other pests involves introducing into the environment their natural enemies, such as parasites, disease organisms and predatory animals [8]. Larvivorous fishes are more efficient to control mosquito at their larval stages. Larvivorous fish like *Gambusia affinis* and *Poecilia reticulata* have been used worldwide for controlling mosquito larvae.
Recently, researchers have evaluated local fish species to identify appropriate local biological control agents [6]. A number of studies have found the introduced fish species, *Gambusia affinis* and *Poecilia reticulata*, and indigenous species to be effective at suppressing mosquito populations breeding places [9, 10, 11]. But, it must be concerned when introducing exotic fish for mosquito control is their impact on native species [12, 13]. The introduction of *G. affinis* in Greece led to a decline of the endemic fish species *Valencia letourneuxi* Sauvage [14] and similar findings were reported in United States, Spain, Australia [15, 16,17]. Due to the problems with introducing exotic species have encouraged to use of native species for controlling mosquitoes [18,19,20,21,22,23].
Use of larvivorous fishes in the field of mosquito control is well documented [4,18, 19,24,25,26,27,28,29,30, 31,32] .Keeping this in view, the present work was carried out to study the feeding potentiality of mosquito larvae by three indigenous larvivorous fish in Assam, India.

MATERIALS AND METHOD
Collection and acclimatization of fish
Three fish species viz. *Channa gachua*, *Puntius sophore* and *Trichogaster fasciata* were collected from a wetland near Dibrugarh University of Assam. Three size groups of *C. gachua* and two size groups were selected for other two fish species. The fishes were taken to the laboratory and kept in aquaria with 3l water separately. They were then acclimatized to the laboratory condition for 3 days and artificial feeds were supplied. For *C. gachua*, size groups were ranged between 6cm and 9.5cm; for *P. sophore*, it was 4.8-5.7cm and for *T. fasciata*, it was ranged from 4-7.1cm.

Collection of food

Mosquito larvae for the experiment were collected by fine net from various waterbodies of Dibrugarh town and transported to the laboratory. They were maintained in 5l glasswares before using them in the experiment. Then IV instar larvae were selected for the experiment.

Known numbers of mosquito larvae along with selected fish species were introduced in three different aquaria. Experiments were conducted in both day and night with a time period of 12h and 24h respectively. In the nighttime experiment, all the size groups were kept in dark room. However, 1h time interval was also set at the daytime to observe the feeding intensity of selected species.

A non-parametric ANOVA was conducted for significant differences in the mean mosquito larvae consumed by each species.

RESULTS AND DISCUSSION

The consumption of mosquito larvae by different size groups at different time intervals was given in the Table 1.1, 1.2, 1.3 and 1.4. During 1h experiment, it was found that an individual *Channa gachua* (9.5cm) consumed a maximum number of mosquito larvae (179±21.21) followed by other two size groups of the same species. Similarly, *P. sophore* (5.7cm) and *T. fasciata* (7.1cm) consumed a maximum of 66.33±1.52/hr and 45.67±0.58 /hr respectively. Again, it was observed that all the fish species consumed maximum numbers of mosquito larvae at first 30 minutes and thereafter the feeding intensity was progressively slowed down (Table 1.1).

The feeding intensity of the studied fish species was significantly different (Table1.2).However, the quantum of feeding at 12h (day), 12h (night) and 24h duration indicated that *C. gachua* consumed highest numbers of mosquito larvae (Table 1.2,1.3 & 1.4) than the other two species. The feeding efficacy of fishes was found to increase on increasing size groups in all the three species studied. All groups of fish species were significantly different on feeding of mosquito larvae. Moreover, it was reported that the average consumption rate of guppy (*Poecilia reticulata*) was 41.0 per day per fish [33] and the larval consumption of *Aphanius chantrei* ranged between 29.62 (27mm) and 151.25 number fish/hr (47mm) [22]. In the present study, the consumption rates were comparatively higher than the mentioned experiments.

There are some reservations about biological control against malaria and they considered it to be more difficult to use than chemicals [34] and sometimes agents can be effective in controlling vectors at laboratory conditions, but they may fail in the field. In addition to that they may also be specific in terms of type of mosquito to be controlled and the type of habitat for their performance. It has been found that introduction of the exotic, voracious and aggressive *G. affinis* actually led to the elimination of native fishes very significantly [6]. *Channa gachua* is a voracious feeder and carnivorous in nature and therefore, it consumes large number of mosquito larvae if available in the surrounding. However, it attacks other fish species at night in the absence of mosquito larvae or preferred food in the environment. *P. sophore* and *T. fasciata* on the other hand, are omnivorous and they swift to algal and planktonic food if mosquito larvae are not around their vicinity. Moreover, carnivores like *Channa gachua* in particular consume all types of mosquito larvae. The intensive use of chemicals for controlling of mosquito larvae resulted resistant strains, decline in beneficial insect species, outbreak of secondary pests, contamination of the environment and food stuffs, and bioaccumulation of pesticide residues in non-target organisms, including human [35].

The use of chemicals in mosquito control appears to have many disadvantages. It is harmful to non target populations as well as the environment and it also causes resistant to mosquitoes which make their control to be more difficult in the future. There are a number of mosquito-borne diseases. The mosquito control process requires alternative simple and sustainable methods of control. Biological control has many advantages as compared to chemicals because it can be effective and safe to human and non-target populations, it has low cost of production and lower risk of resistance development [36]. The mosquito fish *G. affinis* seems to have some negative effects on local fish fauna and the environment but *C. gachua, P. sophore* and *T. fasciata* are excellent agents for use as biological control of mosquito larvae. Moreover, these three fish species well habitant in all waterbodies like wetlands, rivers, ditches etc. Again, *C. gachua* and *T. fasciata* can tolerate turbid water and therefore they can adjust themselves easily in unclean water. As *C. gachua* is carnivorous in food habit, mass production of the fish for restocking has some disadvantages such as of adult fish can attack other young fish. Unlike exotic species, these fish species do not cause any harm to other native fish. They breed naturally and this is a great advantage. Therefore, biological control of mosquito larvae with indigenous larvivorous fish can be applied in integrated pest management program which will be ecofriendly and economically viable too.

Table 1.1: Feeding efficacy of the fish during 1h experiment

Sl. No.	Fish name	Size groups (cm)	No. of larvae consumed/fish	F value
1.a	*Channa gachua*	9.5	179±21.21	8 330.26
1.b	*C. gachua*	8.1	107.6±2.83	
1.c	*C. gachua*	6	101.5±4.95	
2.a	*Trichogaster fasciata*	7.1	45.67±0.58	1800.00
2.b	*T. fasciata*	4	25.67±0.58	
3.a	*Puntius sophore*	5.7	66.33±1.52	3.27
3.b	*P. sophore*	4.8	64.33±1.15	

Table 1.2: Feeding efficacy of the fish during 12h daytime experiment

Sl. No.	Fish name	Size groups (cm)	No. of larvae consumed/fish	F value
1.a	*Channa gachua*	9.5	210.67±9.45	2597.73
1.b	*C. gachua*	8.1	115±5	
1.c	*C. gachua*	6	69±5.29	
2.a	*Trichogaster fasciata*	7.1	101.67±1.53	1421.00
2.b	*T. fasciata*	4	67.83±0.29	
3.a	*Puntius sophore*	5.7	67±1	56.18
3.b	*P.sophore*	4.8	65.67±2.08	

Table 1.3: Feeding efficacy of the fish during 12h nighttime experiment

Sl. No.	Fish name	Size groups (cm)	No. of larvae consumed/fish	F value
1.a	*Channa gachua*	9.5	217.67±3.51	330.26
1.b	*C. gachua*	8.1	215.33±1.53	
1.c	*C. gachua*	6	81.67±3.51	
2.a	*Trichogaster fasciata*	7.1	113.5±0.5	18816.00
2.b	*T. fasciata*	4	57.5±0.5	
3.a	*Puntius sophore*	5.7	109.67±1.52	12.50
3.b	*P. sophore*	4.8	106.33±0.58	

Table 1.4: Feeding efficacy of the fish during 24h experiment

Sl. No.	Fish name	Size groups (cm)	No. of larvae consumed/fish	F value
1.a	*Channa gachua*	9.5	259±3.61	3264.34
1.b	*C. gachua*	8.1	149.67±1.53	
1.c	*C. gachua*	6	72±3	
2.a	*Trichogaster fasciata*	7.1	247.67±2.52	3737.98
2.b	*T. fasciata*	4	95.5±3.5	
3.a	*Puntius sophore*	5.7	179.33±2.08	12.02
3.b	*P. sophore*	4.8	171±3.61	

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