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Studies on Larval Development of Mosquitofish, G*ambusia affinis* (Baird and Girard, 1853) in Bangladesh

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Abstract: *Gambusia* is an economically important fish for controlling insect pests and decorating aquarium by ornamental varieties. The study on *Gambusia affinis* was conducted during January to December, 2008 in the Curzon Hall Area, University of Dhaka, Bangladesh. The reproductive season of *Gambusia* begins on in March and ends in October and was found to be multiple breeders. Larger female produce large number of offspring than smaller females and the number of the young decreases as the season progresses. The anal fin of the females become small and rounded while the males become elongated and tube shaped at the age of 28 days. Fin rays observed in adult males but not in females and the abdomen of the females becomes fatter and larger. Females are larger in size and weight than males.

Key words: Mosquitofish · Gambusia affinis · Larval development · Bangladesh

INTRODUCTION

The Mosquito fish, *Gambusia affinis* (Poeciliidae, Cyprinodontiformes) is a freshwater fish, also commonly known by its generic name, gambusia. *G. affinis*, originally came from North America and has been distributed all over the world for the biological control of mosquitoes. This is one of the exotic species in Bangladesh which is native to the watershed of the Gulf of Mexico [1] and is well known as a biological agent in controlling the larval population of mosquito [2-7]. Hidebrand in 1921 [8] observed one large female to eat 225 larvae and pupae within a 1 one hour period. In another instance, a pair of half grown *Gambusia* consumed over 5000 larvae in 11 weeks [9]. All sizes and ages of *Gambusia* readily feed on mosquito larvae and fry only a few hours old will attack young instars.

The fast-acting residual insecticides are used widely for mosquito control throughout the world which are shorter-lasting, costly and affect the environment adversely. Owing to the evolution of resistant mosquito strains, these insecticides are less effective [10, 11]. So, the development of an effective alternative method is desirable. The biological control of mosquito by *G. affinis* can be one of such approaches.

In Bangladesh, it has been a common practice to introduce suitable species of fish from abroad for controlling insect pests, decorating aquarium by ornamental varieties and for increasing the overall production of food fishes. About 16 species of feed fish have been introduced in the country to serve as one or other purposes indicated above [12]. *G. affinis* was introduced in the 1930s/1940s to control mosquito and it was distributed all over the country including Curzon Hall (the study area).

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An understanding of the reproductive biology and breeding pattern of Mosquito fish is a basic requirement for the successful control of mosquito. Importance of the breeding biology of any fish is essential for evaluating the commercial potentialities of its stock culture practices and actual management of the fishery [13].

In Bangladesh, research has been carried out on the bio-control of mosquito larvae especially by *Poecilia reticulata.* [14, 15]. But information on *Gambusia* breeding is relatively scarce. The present paper deals with the larval development of *G. affinis*.

MATERIALS AND METHODS

The experiments were conducted in the Zoological garden laboratory in the Curzon Hall Campus of Dhaka University. Eight pairs of *G. affinis* were collected from the drains of Curzon Hall and were transferred to the brood-rearing aquariums. All samples were collected by using dip net with a 1 mm mesh-size. In the drains of the research area, the water is still and 20 to 60 cm deep. Male and female fishes were identified from the morphology of the anal fin because the anal fin of the males takes the form of a gonopodium. [16]. The structure of the gonopodium is a significant criterion in the distinction of the Mosquito fish species [17].

The experiment was designed with seventeen brood-rearing aquariums. One aquarium was used for stock culture. Eight couples were transferred to eight aquariums. One couple from first brood of each pair is transferred to eight brood-rearing aquariums to observe the time required for each fish to become sexually mature. Breeding season was observed during the experiment time. Larval development was observed twice a day cautiously. Length and weight of each fish was measured. After the babies were born, mother was removed from the aquarium because she will eat her young as will most fish that see them. Plants were provided as hiding place for the fish during fertilization.

RESULTS AND DISCUSSION

The larval development of *G. affinis* is presented as per week base. In total 16 individuals were observed to collect data on larval development. The external characteristics of both males and females of this fish are almost similar. The distinguishing characteristics remain in the anal fin, abdomen and fin rays as well as the body size.

At birth: A newly hatched larva was characterized with flat head, silvery body, protrusible and terminal mouth, pectoral fin larger than pelvic, caudal fin truncate and with dark spots. The anal fin of both sexes is similar. Pectoral fin is larger than pelvic. Caudal fin truncate and with dark spots. The average length is 0.78 ± 0.05 cm (Table 1). The anal fin of both sexes is similar up to 14 days old larvae.

At 21 Days: The anal fin of the females become small and rounded while the males become elongated and tube-shaped. Fin rays were observed in males but not in females.

At 28 Days: The size of the females become larger compare to that of males.

At 35 Days: The abdomen of the females become fatter and larger compared to that of males.

Table 1: Length of offspring of *G. affinis.*

			Length of offspring (0 days) (cm)		
Name of the pair	Total no. of broods	Total no. of offspring	Range	Average ± SD	Mean ± SD
1st	3	26	0.6-1.0	0.8 ± 0.1	0.78 ± 0.05
2nd	3	24	0.6-1.1	0.8 ± 0.2	
3rd	4	38	0.6-0.9	0.7 ± 0.1	
4th	2	10	0.5-0.9	0.7 ± 0.1	
5th	3	14	0.5-1.0	0.8 ± 0.2	
6th	3	34	0.6-1.0	0.8 ± 0.1	
7th	4	53	0.6-1.2	0.8 ± 0.2	
8th	3	23	0.6-0.9	0.8 ± 0.1	

At 42 Days: A dark spot surrounding the anus and urogenital area of the females present while absent in that of males.

At about 49 Day's Age: The males and females become sexually mature and ready to mate.

In the present study it was observed that *G. affinis* can reproduce at an age of 49 ± 3.20 days (Table 1). Menon and Rajagopalan [18] on *P. reticulata*, a closely related fish in Pondicherry reported that this fish can reproduce at the age of 90 days.

From the study it was revealed that the length of the offspring increases in relation to their age, which is statistically significant (Fig - 1).

Biological control, particularly using larvivorous fish, was important to malaria control programmes in the 20th century, particularly in urban and periurban areas for immediate use in developed and developing countries [19]. It has a very positive role to play in the integrated control methodologies in which both pesticides and fish or other biotic agents have their own roles (120). Biological control refers to the introduction or

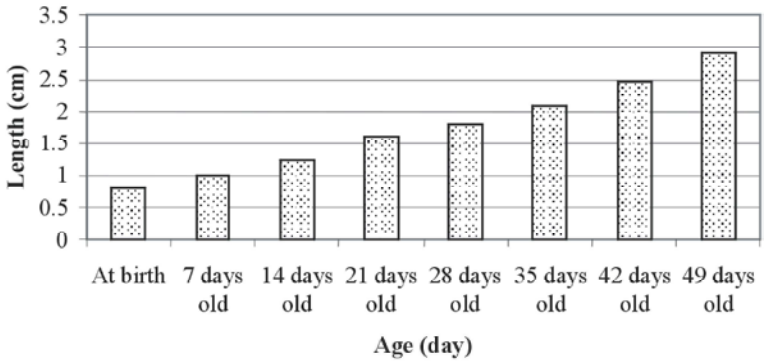

Fig 1: Larval development in relation to age

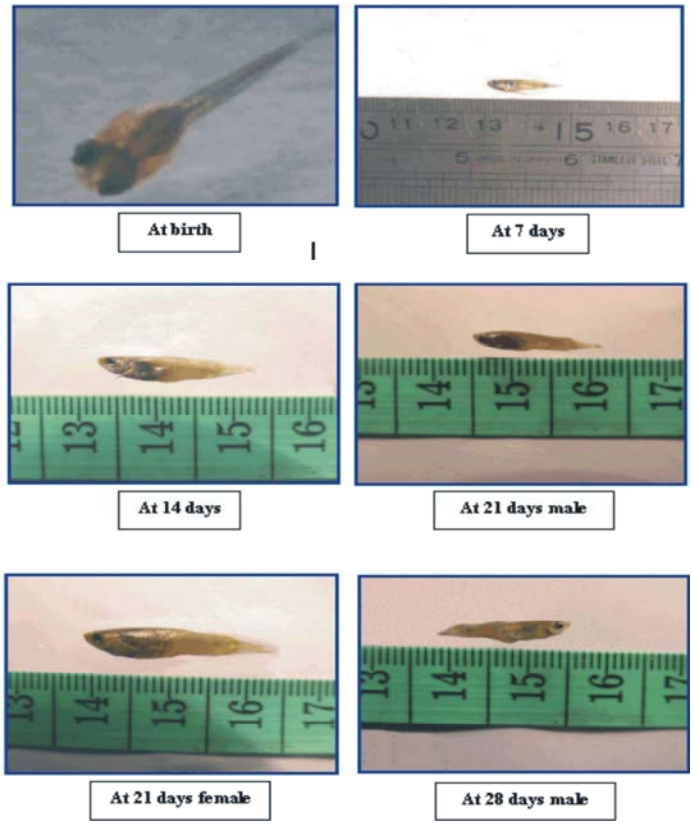

Fig 2: Larval development of different stages of life cycle

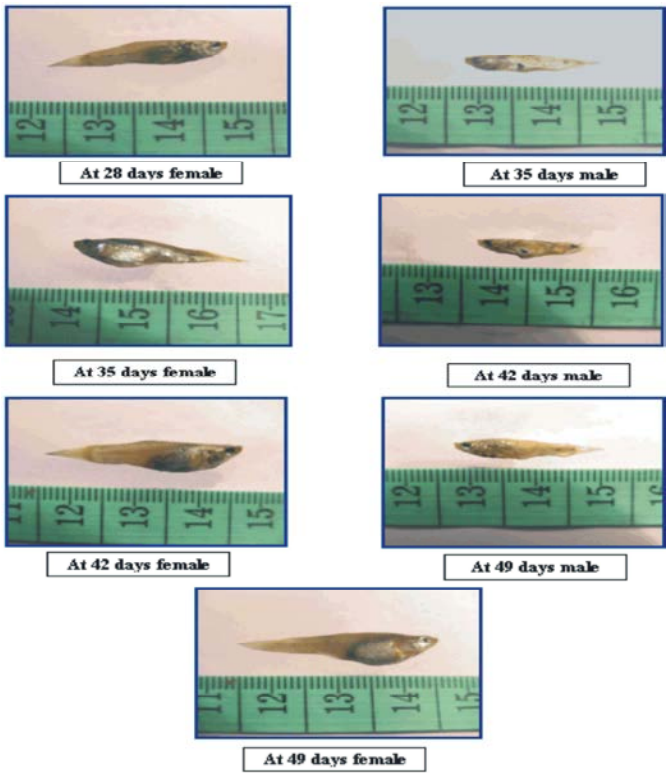

Fig 2: Larval development of different stages of life cycle

manipulation of organisms to suppress vector populations. A wide range of organisms helps to regulate mosquito populations naturally through predation, parasitism and competition. As biological mosquito control agents, larvivorous fish (*i.e.*, those that feed on immature stages of mosquitoes) are being used extensively all over the world since the early 1900s (pre DDT era) [21]. During the pre DDT era, control of mosquitoes and mosquito vectors of different mosquito borne diseases was undertaken mainly by environmental management, pyrethrum space spraying, use of Paris green, oiling with petrol products and introduction of larvivorous fish. Recognizing the high larvivorous potential of *Gambusia affinis*, this fish species was purposely introduced from its native Texas (Southern USA) to the Hawaiin Islands in 1905. In 1921, it was introduced in Spain; then from there in Italy during 1920s and later to 60 other countries [22]. Beginning in 1908, another larvivorous fish, *Poecilia reticulata*, a native of South America, was introduced for malaria control into British India and many other countries [22]. The introduction of the use of DDT in indoor residual spraying for malaria control around the mid-1940s led to the gradual decline in the use of concepts of environmental management and biological control methods, except in a few programmes in Russia. In the fifties, attention was directed to eradicate mosquitoes using synthetic insecticides until insecticide resistance began to assume prominence. In 1969, the WHO changed its strategy of malaria eradication by spraying houses with synthetic insecticides in favour of the more realistic one for the control of mosquito populations in the larval stages (post DDT era) [21]. The selection of biological control agents should be based on their potential for unintended impacts, self-replicating capacity, climatic compatibility and their capability to maintain very close interactions with target prey populations [23]. They eliminate certain prey and sustain in such environments (*i.e.*, they eat the prey, when introduced) for long periods thereafter [24]. However, this will only be possible if the predator possesses extraordinary search efficiency irrespective of the illuminated situation in response to the emergence of prey. It is important to have a sound knowledge of predator's prey selective patterns and particularly of its mosquito larval selection in the presence of alternate natural prey [25, 26]. In addition, the predator's adaptability to the introduced environment and overall interaction with indigenous organisms need

to be considered prior to introduction [27, 28]. This review presents a brief account of larvivorous fish as mosquito control agents and possible prey/predator interactions in aquatic ecosystems.

It is hoped that the biological data obtained from this study will help in further planning and modification of the efforts in mosquito control.

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