Food Preference of *Aplocheilus panchax* (Cyprinidontiformes : Aplocheilidae) with Special Reference towards Mosquito larvae

N. Pemola Devi, R.K. Jauhari[1]

Dept. of Zoology, D.B.S. (P.G.) College, Dehradun – 248001, India
[1]Dept. of Zoology, D.A.V. (P.G.) College, Dehradun – 248001, India
npmola@rediffmail.com; jauharirk@hotmail.com

Abstract: As there is a lack of study on food intake by larvivorous fish in general and *Aplocheilus panchax* (Cyprinidontiformes: Aplocheilidae) in particular, henceforth a study on food preference by the fish with special reference to Anopheline mosquito larvae has been taken up with aims of its application in field conditions in controlling mosquito population. The test fishes were collected from water fragments of Loktak lake in Manipur state, India. Two experiments were designed - first experiment on the size range food preference between live and artificial food when supplied separately while the second one is based on size range specific preference towards different food items when supplied together. The consumption rate of fish was found higher towards mosquito larvae than chironomids larvae and artificial food. The consumption rate of fish increases on increasing size range. Two-way ANOVA was followed for 2 source of variance *i.e.*, size of fish and food types. A comparison has been made using F-test at 1% level of significance. The fish *Aplocheilus panchax* showed higher preference to live food and that too on Anopheline larvae; it is presumed that this fish could be one of the efficient biocontrol agents in fields and thus in reducing mosquito borne diseases.
[N. Pemola Devi, R.K. Jauhari. Food Preference of *Aplocheilus panchax* (Cyprinidontiformes: Aplocheilidae) with Special Reference towards Mosquito larvae. Researcher. 2011;3(6):55-59]. (ISSN: 1553-9865). http://www.sciencepub.net.

Key words: *Aplocheilus panchax*; mosquito / chironomids larvae; artificial food; food preference

1. Introduction

The food is the most important and vital factor in determining the population levels, rate of growth and condition of fish. It has an influence on the feeding habits of fish which ultimately signifies aquaculture practices, besides the role of fishes as biocontrol agents in field conditions along with other fishes. Using larvivorous fishes in mosquito control programme is the oldest and presently the most popular biocontrol method for eliminating or reducing larval population.

Among the larvivorous fishes, mosquito fish (*Gambusia sp.*) and guppy (*Poecilia sp.*) are most popular throughout the world and even for more than 100 years, the mosquito fish has been used as a biocontrol agent (Walton, 2007 and Chandra *et al.*, 2008). In India, both these fishes have been successfully utilized as the potential biocontrol agents for a long time and to some extent *Aplocheilus* sp. has also been used for controlling mosquito population (Kumar *et al.*, 1998). On the other hand, studies on the gold fish, *Carassius auratus* (Linn., 1758) as a good consumer of mosquito larvae have also been performed in minimizing mosquito population (Chatterjee *et al.*, 1997). Just contrary to this, Gupta and Banerjee (2009) mentioned that gold fish preferred to feed more towards chironomus larvae than mosquito larvae when supplied together.

Based on an extensive literature survey on food preferences of larvivorous fish in presence of alternate food, it seems that there is a lack of study on food intake by the larvivorous fish, *Aplocheilus panchax*. Since this fish has shown an extensive larvivorosity towards *Anopheles annularis* larvae in the fragments of Loktak lake in Manipur state (Pemola *et al.*, 2010) it is desired to work out food preference of the fish so that it could be applied in field trials under mosquito control programme.

2. Material and Methods

2.1 Collection and acclimatization of Fish

The specimens of *Aplocheilus panchax* ranging between 3-9 cm. were collected from water fragments of Loktak lake, the largest freshwater wetland of Northeast located in Bishenpur district in Manipur state (India). The fish specimens were brought to research laboratory at Department of Zoology, D.A.V. (P.G.)

College, Dehradun (India) and grouped into three categories based on length as 3-5 cm., 5-7 cm. and above 7 cm. They were kept separately in 5 lit. glass jars at a density of 5 fish / jar with proper aeration, photoperiod (12 L: 12 D) and temperature (27 ± 2ºC) for one week to acclimatize at laboratory conditions, however, the commercial feed was supplied regularly.

2.2 Collection of mosquito/chironomids larvae

Mosquito larval collection was made using standard methods (WHO, 1975) from water filled pots maintained for mosquito breeding in the Department. The larvae were kept in enamel trays and supplied with proper amount of yeast powder and dog biscuits. By dredging the bottom mud from the pots and tanks maintained for mosquito and fish culture respectively, the chironomids larvae (*Chironomus* sp.) were collected and kept in enamel trays. For experimental work III & IV instar larvae were collected from the lot. Standard artificial food (Tokyu, granulated form, diameter 1.3 ± 0.37 mm), brought from the local aquarium shop was supplied for feeding purpose of fish.

2.3 Experimental setup

2.3.1 Experiment I

Based on the size range of food preference of *A. panchax* between live and artificial food, the experiment was conducted in three parts. The first part of the experiment was designed to know the size range preference of fish for individual food items when food items were supplied separately. For this experiment, individual fish of each of the three different size groups was kept separately in 5 lit. glass jars at the density of 5 fish / jar. The fishes were held in the jars for 24 h. prior to the commencement of the experiment and kept without food to standardize hunger level. Each of these fishes was then provided daily with 300 mosquito larvae for the first seven days, along with 300 chironomids larvae for next seven days and with 300 Tokyu granules (baby pellet) for the last seven days of the experiment. On each day, after one hour of supply of the food items, the remaining amount of each food item was counted. This experiment was conducted in five replicates for each set up. Table 1 summarizes the results represented as mean ± SD.

2.3.2 Experiment II

This was designed to know the size range specific preference of *A. panchax* towards different food items (mosquito larvae, chironomids larvae and artificial food) when the food items were supplied together. For this, individuals of *A. panchax* of each of the three different length groups were kept separately in 5 lit. glass jars at the density of 5 fish / jar. Similar to previous experiment, different length groups of fish were kept separately and held in the jars for 24 h. prior to the commencement of the experiment so that they could be acclimatized. Each of these fishes was then supplied with equal amount (300 in number each) of mosquito larvae, chironomids larvae and artificial food together at the same time. After 3 hours, the remaining amount of each food item was counted. This experiment was also conducted in five replicates (Table 1).

2.4 Statistical analysis

For both experiments, the mean consumption rate along the standard deviation of means was calculated. Two-way ANOVA was followed for two source of variance *viz*., size of fish and food types for each day of observation. Pooled ANOVA technique repeated over days was also followed to describe in detail about the size of fish *vs.* food items consumed if found significant. The comparison was made using F-test at 1% level of significance.

4. Results

In the first part of the experiment, three types of food items *i.e*., mosquito and chironomids larvae (live) and Tokyu granules (artificial) were supplied separately to all the three different length groups of fish. Within 3 hours the mean number of mosquito larvae consumed ranged from 23.6 to 58.48 (Table 1). In fact, higher consumption was found in size range of above 7 cm. The consumption rate towards chironomids larvae ranged from 17.84 to 42.08 and for artificial food from 7.72 to 28.72. In the second experiment, when mosquito larvae, chironomids larvae and artificial food were supplied together to three different length groups, all the groups showed higher preference for mosquito larvae than chironomids larvae and artificial food (Table 1). The mean consumption rate of fish on mosquito larvae ranged from 21.5 to 58.64 but on chironomids larvae and artificial food it was in the range of 4.2 to 8.6 and 0.28 to 4.24 respectively.

The two-way factorial ANOVA revealed that food consumption of *A. panchax* on different food types varied between the numbers consumed as well as the size range; highly significant when the food types are

supplied separately. On the other hand, when different food types were supplied together, the consumption rate of fish varied between numbers of food consumed and size range, significantly ($p<0.0001$) but on chironomids significant ($p<0.0001$) difference between the size range as well as food types. It was also observed that although above 7 cm sized *A. panchax* showed significantly ($p<0.0001$) higher preference for mosquito larvae it was found not significant ($p< 0.01$) (Table 2). The results of two-way factorial ANOVA on the effects of size range and food types when supplied separately or together, all size range of fish always showed larvae than chironomid larvae but overall it's preference for live food was significantly ($p<0.0001$) higher than artificial food (Table 3).

Table 1: Food consumption rate of different size range of *Aplocheilus panchax* towards mosquito / chironomids larvae and artificial food when supplied separately / together.

Food types	Consumption rate / fish (different size) within 3 h.					
	3-5 cm.		5-7 cm.		Above 7cm.	
	SS	ST	SS	ST	SS	ST
Mosquito larvae	23.6 ± 2.47	21.52 ± 2.85	38.36 ± 3.95	35.76 ± 3.78	58.48 ± 2.24	58.64 ± 1.59
Chironomids larvae	17.84 ± 2.22	4.92 ± 2.002	26.76 ± 2.79	4.2 ± 1.56	42.08 ± 4.98	8.6 ± 1.13
Artificial food	7.72 ± 0.54	0.2 8 ± 0.33	17.32 ± 2.07	4.04 ± 1.51	28.72 ± 3.028	4.24 ± 0.81

SS= Supplied separately; ST= Supplied together

Table 2: Results of two-way factorial ANOVA on the effects of food consumed (Nos.) and size range in *Aplocheilus panchax* (n = 5 observations per size group)

Source of variation	Food types	Sum of squares	df	Mean square	F
No. of food consumed & size range when kept separately	Mosquito larvae	24283.76	14	1541.69	*191.59
	Chironomids larvae	1653.4	14	764.02	*60.02
	Artificial food	1160.23	14	557.18	*120.65
No. of food consumed & size range when kept together	Mosquito larvae	3606.96	14	1761.805	*210.3
	Chironomids larvae	8933.24	14	1392.95	1.266 ^{NS}
	Artificial food	69.6	14	26.53	*15.07

*All F-values significant at $P < 0.0001$ level; NS = Not significant at $P<0.01$ level

Table 3: Results of two-way factorial ANOVA on the effects of size range and food types in *Aplocheilus panchax* (n = 5 observations per size group)

Source of variation	Size ranges	Sum of squares	df	Mean square	F
Size range & food types when kept separately	3-5 cm	691.88	14	326.94	*85.03
	5-7 cm	1221.67	14	564.51	*59.96
	Above 7 cm	2377.99	14	1123.93	*85.37
Size range & food types when kept together	3-5 cm	1303.66	14	580.84	*39.9
	5-7 cm	3181.41	14	1558.86	*243.9
	Above 7 cm	9174.32	14	4579.65	*3072.5

*All F-values significant at $P < 0.0001$ level.

Henceforth, from the first experiment it is clear that all the three size groups of killi fish have significantly higher preference for live food than the artificial food. Among the live food supplied in the experiment, mosquito larvae were consumed with significantly higher preference than chironomids larvae by both the groups *i.e.*, 3-5 cm and 5-7 cm. sized *A. panchax.* So much so, the fish above 7 cm in length also exhibited significantly higher preference for mosquito larvae when supplied along with chironomids larvae.

4. Discussion

In the present study, all the three length groups of the chosen fish have shown preference on live food than the artificial one; exhibiting a choice towards mosquito larvae than chironomids larvae. As *Aplocheilus panchax* is a typical surface feeder and thus it mainly prefers to take food from surface and sub surface environment (Jacob and Nair, 2006). Meanwhile, chironomid larvae are benthic in nature (Real *et al.*, 2000; Henriques-Oliveira *et al.*, 2003; Ozkan 2006 and Silva *et al.*, 2008) while mosquito larvae are surface breather; most of the times stay at water surface and have fast wriggling behaviour than chironomids larvae.

Meanwhile, the biological control of immature mosquito by larvivorous fishes has proven to be successful in stable water bodies, usually in good water quality conditions, however, the problem of mosquito nuisance is mainly associated with polluted water with almost anoxic condition and with toxic metabolites before monsoon and in clear water after monsoon months. In the past, as per observations of Pant *et al.* (1981) the three major criteria for a fish to be used as mosquito biocontrol agents are - first of all it should be with high predation efficiency towards mosquito larvae, secondly, there must be resistance to anoxic conditions including high tolerance to insecticides and lastly it should have high reproductive potential.

Studies on food preference of a gold fish, *Carassius auratus* and its potential in mosquito control (Gupta and Banerjee, 2009) revealed that the fish had a higher preference for live food than artificial food, most preferably for chironomids larvae. The findings of the present study exhibit a similarity with respect to preference for live food than artificial food while there is difference as *A. panchax* showed preference to mosquito larvae than chironomids larvae. While undertaking studies on food intake by *G. affinis* and *P. reticulata,* Reddy and Shakuntala, 1979 recorded that if *Tubifex tubifex* is available as another prey along with mosquito larvae, both the fishes tend to feed preferentially on the worms than on mosquito larvae. Similar to this experiments were conducted towards vulnerability of the live food to *P. reticulata* by Manna *et al.* (2008) that showed low preference for mosquito larvae as compared to chironomids larvae and tubificid worms. This is just contrary to present findings. However, there is a similarity with regard to the prey consumption ability of larvivorous fish that increases with body size (Manna *et al*., 2008).

The present findings showed a high preference for mosquito larvae by *A. panchax* in presence of commercial fish food, this differs with *P. reticulata* and that too its consumption towards *Aedes* mosquito larvae (Ekanayake *et al.*, 2007). Similar to our studies, survival rate of *Channa striatus* larvae showed significantly gain in growth rate and weight when feed on mosquito larvae followed by Chironomus larvae and plankton (Kumar *et al.*, 2008). Recently, Patra (2010) conducted laboratory experiments on the feeding patterns of ornamental fish towards mosquito larvae in domestic well water and noted a preference towards zero instars and 1st & 2nd instars than 3rd instars and pupae while the findings of present study are based on 3rd and 4th instar larvae only.

Based on the above consideration, there seems to be two main factors determining the efficacy of the larvivorous fishes to intake the food – feeding behaviour of the selected fish and nature of live food (habitat). As the fish *A. panchax* showed high preference to live food and that too on Anopheline mosquito larvae in presence of other food, it is presumed that the chosen fish could be one of the efficient biocontrol agents in fields.

Acknowledgements:

One of us (NPD) is thankful to the Department of Science & Technology (Govt. of India), New Delhi for funding as Women Scientist Fellowship (WOS-B). Thanks are also due to the Principal, D.B.S.(P.G.) College, Dehradun (India) for co-operation and to the Principal, D.A.V.(P.G.) College Dehradun (India) for extending laboratory facilities as and when needed.

Correspondence to:
N. Pemola Devi
Dept. of Zoology,
D.B.S. (P.G.) College, Dehradun – 248001, India,
Fax : 91-135-2741147
Ph.: 91-135-2748548 (Off.)
Email: npmola@rediffmail.com

References

[1] Walton WE. Larvivorous fish including *Gambusia*. In Floore, T., editor. *Biorational control of mosquitoes.* J Amer Mosq Cont Assoc. 2007; 23(sp 2): 184-220.

[2] Chandra G, Bhattacharjee I, Chatterjee SN, Ghosh A. Mosquito control by larvivorous fish. Ind J Med Res. 2008; 127: 13-27.

[3] Kumar A, Sharma VP, Sumodanm PK, Thavaselvam D. Field trials of biolarvicide *Bacillus thuringiensis* var. *israelensis* strain 164 and the larvivorous fish *Aplocheilus blocki* against *Anopheles stephensi* for malaria control in Goa, India. J Amer Mosq Cont Assoc. 1998; 14**:** 457-462.

[4] Chatterjee SN, Das S, Chandra G. Gold fish (*Carrasius auratus*) as a strong larval predator of mosquito. Transc Zool Soc India. 1997; 1(1):112-114.

[5] Gupta S, Banerjee S. Food preference of gold fish (*Carassius auratus* Linnaeus, 1758) and its potential in mosquito control. Electronic J Ichthyol. 2009; 2: 47-58.

[6] Pemola Devi N, Jauhari RK, Hasan SF. Water quality and larvivorous activity of a killifish, *Aplocheilus panchax* (Ham.) against *Anopheles annularis* larvae in fragments of Loktak lake (Manipur). J Expt Zool India. 2010; 13(2): 509-512.

[7] WHO. Manual on practical entomology in malaria Part II- Methods and Techniques, Offset Publication, WHO, Geneva 1975; 1-191.

[8] Jacob SS, Nair NB. Food and feeding habits of the larvivorous fish *Aplocheilus lineatus* (Cuv. & Val.) in its natural habitat. J Fish Biol. 2006; 20(3):329-339.

[9] Real M, Rieradevall M, Prat N. Chironomus species (Diptera: Chironomidae) in the profundal benthos of Spanish reservoirs and lakes: factors affecting distribution patterns. Freshwater Biol. 2000; 43(1): 1-18.

[10] Henriques-Oliveira AL, Nessimian JL and Dorville LFM. Feeding habits of Chironomid larvae (Insecta: Diptera) from a stream in the Floresta da Tijuca, Rio de Janeiro, Brazil. Braz J Biol. 2003; 63(2): 269-281.

[11] Őzkan N. The larval Chironomidae (Diptera) fauna of Bozcaada (Tenedos). Gazi Univ J Sci. 2006;19 (1): 57-67.

[12] Silva FL, Ruiz SS, Bochini GL, Moreira DC. Functional feeding habits of Chironomids larvae (Insecta, diptera) in a lotic system from Midwestern region of Sao Paulo State, Brazil. Pan Amer J Aqua Sci. 2008; 3(2):135-141.

[13] Pant C, Rishikesh N, Bang YH, Smith A. Progress in malaria vector control. Bull WHO. 1981; 59: 325-333.

[14] Reddy SR, Shakuntala K. Comparative studies on the food intake, growth and food conversion of two larvivorous fishes. Proc Indian Acad Sci.1979; 88B Part I(6):425-432.

[15] Manna B, Aditya G, Banerjee S. Vulnerability of the mosquito larvae to the guppies (*Poecilia reticulata*) in the presence of alternative preys. J Vect Borne Dis. 2008; 45: 200-206.

[16] Ekanayake DH, Weeraratne TC, De Silva WAPP, Karunaratne SHPP. Potential of some selected larvivorous fish species in *Aedes* mosquito control. Proc Peradeniya Univ Res Sessions, Sri Lanka 2007; 12(I): 98-100.

[17] Kumar D, Marimuthu K, Haniffa MA, Sethuramalingam TA. Effect of different live feed on growth and survival of striped murrel *Channa striatus* larvae. E.U. J Fisheries & Aqua Sci. 2008; 25(2):105-110.

[18] Patra AK. Laboratory trials on the feeding pattern of mosquito larvae by ornamental fishes (Mollies and Swordtails) in domestic well water. Uttar Pradesh J Zool. 2010; 30(1): 47-52.

Submission date: 15th April 2011