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A comparative assessment of the *Culex quinquefasciatus* Say, 1823 larvae predation potentiality of two indigenous fish under laboratory condition

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Abstract
In the absence of alternate prey *Stigmatogobius sadanundio* is a better predator as compared to *Aplocheilus panchax* as it consumed significantly more number of Culex as well as Chironomus larvae in both simple and complex habitats. In the presence of alternate prey *A. panchax* consumed significantly more number of Culex larvae as compared to Chironomus larvae in simple habitat but the reverse was true for *S. sadanundio*. In complex habitat both *S. sadanundio* and *A. panchax*, though consumed significantly more Culex larvae as compared to Chironomus larvae, predation rate was slightly higher in case of *S. sadanundio.* Preference index was higher in favour of Culex larvae for *A. panchax* in both simple and complex habitats but it was so for *S. sadanundio* only in complex habitat. Predatory efficiency thus depends on the availability of the alternate prey as well as nature of habitat.

Keywords: Biocontrol, *Stigmatogobius sadanundio, Aplocheilus panchax,* food preference

Introduction
Biological control of mosquitoes using predators is part of an integrated vector management programme [1]. The use of indigenous larvivorous fish nowadays is the most popular and suitable bio-controlling method to eliminate the mosquito larval population [2]. Indigenous larvivorous fish exist naturally in large mosquito breeding grounds and their diet includes mosquito larvae along with several other food resources. To ensure proper and effective control of mosquito larvae through indigenous larvivorous fish, the positive preference for the mosquito larvae need to be tested in the presence or absence of alternate prey and also in simple or complex habitats [1] as in natural condition mosquito breeding grounds are characterised by habitat heterogenicity and presence of an array of food resources for the predator. The presence of alternate prey and habitat complexity are known to influence the prey-predator interaction [2-10]. Several native fish species in India have already been identified as possible biological control agent for mosquito larvae [11]. *Aplocheilus panchax* (Hamilton, 1822) is being used as mosquito larvae controlling agent for a pretty long time and its food preference has previously been assessed by Manna *et al*. [1] and Devi & Jauhari [12]. While Gupta & Banerjee [13] compared the predatory potentiality of this species and *Poecilia reticulata* Peters, 1859, Pahari *et al*. [7] assessed the predatory efficiency of only *Stigmatogobius sadanundio* (Hamilton, 1822). As both *A. panchax* and *S. sadanundio* are commonly found in Purba Medinipur district it was thought pertinent to compare the predatory potentiality of these two fish species in the presence of an alternate prey, *Chironomus ramosus* Choudhuri *et al*., 1992 larvae in two contrasting habitats.

Materials and Methods
S. sadanundio and *A. panchax* were collected using a gill net and a hand net from a pond and a canal of Tamluk. These were kept in a glass aquarium (60 x 30 x 30 cm) containing plankton free pond water and acclimatized for a fortnight before the commencement of experiments. *C. quinquefasciatus* and *C. ramosus* larvae, collected from a drain with stagnant water, using a hand net (mesh size 200 μm), were stocked in an aquarium (60 x 30 x 30 cm) filled with drain water.
Two sets, each with three glass aquaria (30 x 30 x 30 cm) filled with 6 litres of pond water after passing through a plankton net (mesh size 62 μm) were prepared one day before the commencement of each experiment. In the first set one acclimatised *S. sadanundio* and in the second set one acclimatised *A. panchax* of identical length and weight (Table 1) were placed and starved for 24 hours. The experiment commenced in the next morning and continued for 24 hours.

Table 1: Length and weight of *S. sadanundio* and *A. panchax*

	Length ($\bar{x}$ ±SE)	Weight ($\bar{x}$ ±SE)
S. sadanundio	5.73±0.03	2.15±0.04
A. panchax	5.54±0.03	1.99±0.02

For predation preference studies prey items were offered separately and in paired combination. Experiments were conducted in five series. In the first series only *C. quinquefasciatus* larvae were given as prey and in the second series, only *C. ramosus* larvae were given as prey in a simple habitat condition. In third series the experiment was conducted in an altered habitat by adding gravel and sand at the bottom of experimental aquarium. In the fourth series *C. quinquefasciatus* larvae and *C. ramosus* larvae were given together as prey in a 1:1 ratio in a simple habitat condition. In the fifth series, *C. quinquefasciatus* and *C. ramosus* larvae were given together as prey in a 1:1 ratio in a complex habitat condition. All experiments were replicated thrice.
Data collected were analysed by using MS-Excel 2021 and IBM SPSS version 25 software. Dietary preference index was computed using the formula of Chesson [14].

Fig 1: *Stigmatogobius sadanundio*

Fig 2: *Aplocheilus panchax*

Fig 3: *Culex quinquefasciatus* larvae

Fig 4: *Chironomus ramosus* larvae

Result and Discussion

During 24 hours duration in the simple habitat condition although *A. panchax* consumed significantly more Culex larvae as compared to Chironomus larvae, no such significant difference could be seen for *S. sadanundio* even though it predated significantly more Culex and Chironomus larvae as compared to *A. panchax* (Table 2). However, in altered complex habitat not only the predatory efficiency of *S. sadanundio* was found to be significantly more but it also consumed significantly more Culex larvae as compared to Chironomus larvae (Table 3).

Table 2: Number of *Culex* and *Chironomus* larvae consumed in 24 hours when offered separately in simple habitat.

	S. sadanundio	*A. panchax*	t
***Culex* larvae (x̄±SE)**	400.67±4.98	367.67±4.06	9.15*
***Chironomus* larvae (x̄±SE)**	408.33±2.03	285.67±3.48	84.42***
t	-1.994	17.47**	

*p<.05, **p<.01, ***p<.001

Table 3: Number of *Culex* and *Chironomus* larvae consumed in 24 hours when offered separately in complex habitat.

	S. sadanundio	*A. panchax*	t
***Culex* larvae (x̄±SE)**	364.00±7.23	321.67±4.26	4.54*
***Chironomus* larvae (x̄±SE)**	319.67±7.06	243.33±7.45	24.01**
t	50.27***	11.58**	

**p<.05, **p<.01, ***p<.001*

But when larvae of both Culex and Chironomus were offered together in a simple habitat *S. sadanundio* consumed significantly less Culex larvae and *A. panchax* predated significantly more Culex larvae as compared to Chironomus larvae. Likewise consumption rate in 24 hours of Culex larvae was significantly less in case of *S. sadanundio* and the same for Chironomus was significantly more in *S. sadanundio* as compared *A. panchax* (Table 4). In complex habitat when prey species were offered together both the species consumed significantly more Culex larvae as compared to Chironomus larvae but although *S. sadanundio* predated significantly more Chironomus than *A. panchax* the difference was insignificant for Culex larvae (Table 5).

Table 4: Number of *Culex* and *Chironomus* larvae consumed in 24 hours when offered together in simple habitat.

	S. sadanundio	*A. panchax*	t
***Culex* larvae (x̄±SE)**	170.67±4.33	207.33±3.76	-55.00***
***Chironomus* larvae (x̄±SE)**	219.33±3.93	148.67±4.98	58.80***
t	-33.495***	44.000***	

**p<.05, **p<.01, ***p<.001*

Table 5: Number of *Culex* and *Chironomus* larvae consumed in 24 hours when offered together in complex habitat.

	S. sadanundio	*A. panchax*	t
***Culex* larvae (x̄±SE)**	199.33±6.35	180.67±4.91	3.09
***Chironomus* larvae (x̄±SE)**	161.67±4.58	132.33±3.76	5.22*
t	15.10**	40.22***	

**p<.05, **p<.01, ***p<.001*

Table 6: Food preference index for for *S. sadanundio* and *A. panchax*.

	S. sadanundio		*A. panchax*	
	***Culex* larvae**	***Chironomus* larvae**	***Culex* larvae**	***Chironomus* larvae**
Simple Habitat	0.43	0.57	0.58	0.42
Altered Habitat	0.55	0.45	0.58	0.42

Analysis of food preference index (Table 6) revealed that *A. panchax* had a higher preference index for Culex larvae irrespective of the nature of habitat indicating its preference for the Culex larvae over Chironomus larvae. In *S. sadanundio*, on the contrary, the higher preference index for Chironomus larvae in simple habitat shifted in favour of Culex larvae in complex habitat. Earlier studies by Manna *et al*. [1], Devi and Jauhari [12] and Aditya *et al*. [15] are also in agreement of the findings of the present study indicating a definitive preference for mosquito larvae over the alternate prey by *A. panchax* both in simple and complex environment. Pahari *et al*. [7] have also found that *S. sadanundio* has a high predatory efficiency and its food preference shifts in favour of mosquito larvae with the change in habitat from simple to complex.

As such it may be concluded that both the species are effective predators of Culex larvae and their predatory efficiency depend on availability of alternate prey and on the nature of the habitat. It seems *S. sadanundio* has a slight edge over *A. panchax* as a biocontrol agent.

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Reference

1. Manna B, Aditya G, Banerjee S. Habitat heterogeneity and prey selection of Aplocheilus panchax: An indigenous larvivorous fish. J Vector Borne Dis.,2011:48(3):144–9.
2. Pahari PR, Maiti S, Mandal SS, Bhattacharya RP, Bhattacharya T. Culex quinquefasciatus Say, 1823 larvae feeding ability of Puntius sophore (Hamilton, 1822) in laboratory condition. Journal of Entomological Research,2020:44(1):103–6.
3. Warfe DM, Barmuta LA. Habitat structural complexity mediates the foraging success of multiple predator species. Oecologia,2004:141(1):171–8.
4. Hurst TP, Brown MD, Kay BH. Laboratory evaluation of the predation efficacy of native Australian fish on Culex annulirostris (Diptera: Culicidae). J Am Mosq Control Assoc,2004:20(3):286–91.
5. Juliano SA. Species interactions among larval mosquitoes: Context dependence across habitat gradients. Annu Rev Entomol.,2009:54:37–56.
6. Saha N, Aditya G, Saha GK. Habitat complexity reduces prey vulnerability: An experimental analysis using aquatic insect predators and immature dipteran prey. J Asia Pac Entomol.,2009:12(4):233–9.
7. Pahari PR, Mishra NP, Sahoo A, Bhattacharya RP, Bhattacharya T. First record of the mosquito control potentiality of Stigmatogobius sadanundio (F. Hamilton, 1822) Gobiidae, Perciformes in laboratory condition. Trop Parasitol.,2020:10(2):130–5.
8. Pahari PR, Mandal G, Maiti S, Bhattacharya T. Potential of the ornamental fish, Trichopodus trichopterus (Pallus, 1770) in controlling Culex larvae under laboratory condition. Journal of Entomological Research,2021:45:1103–6.
9. Pahari PR, Mandal SS, Maiti S, Mandal S, Bhattacharya T. A study on the culex quinquefasciatus Say, 1823 control potentiality of Colisa fasciata (Bloch & Schneider, 1801) in laboratory condition. Indian J Public Health Res Dev.,2021:12(3):144–9.
10. Sahoo D, Samanta G, De la Sen M. Impact of Fear and Habitat Complexity in a Predator-Prey System with Two Different Shaped Functional Responses: A Comparative Study. Ding X, editor. Discrete Dyn Nat Soc.,2021:2021:1–22. https://doi.org/10.1155/2021/6427864
11. Chandra G, Bhattacharjee I, Chatterjee SN, Ghosh A. Mosquito control by larvivorous fish. Indian Journal of Medical Research,2008:127(1):13–27.
12. Devi NP, Jauhari RK. Food Preference of Aplocheilus panchax (Cyprinidontiformes : Aplocheilidae) with Special Reference towards Mosquito larvae. Researcher,2011:3(6):1–5.
13. Gupta S, Banerjee S. Comparative Assessment Of Mosquito Biocontrol Efficiency Between Guppy (Poecilia reticulata) And Panchax Minnow (Aplocheilus panchax). Bioscience Discovery,2013:4(1):89–95.
14. Chesson J. Measuring Preference in Selective Predation. Ecology,1978:59:211–5.
15. Aditya G, Pal S, Saha N, Saha GK. Efficacy of indigenous larvivorous fishes against Culex quinquefasciatus in the presence of alternative prey: Implications for biological control. J Vector Borne Dis.,2012:49(4):217–25.