MICROHABITAT BREADTH OF FISH COMMUNITY ALONG THE VAMANAPURAM RIVER, SOUTH KERALA

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ABSTRACT

The microhabitat breadth of Vamanapuram River fish community was studied in detail. The microhabitat variables selected were relative depth, focal point velocity, water column depth, mean water velocity and substrate. *Puntius filamentosus* had the highest breadth in three dimensions in both stream and river habitats showing a generalistic mode of resource utilization. *Garra mullya*, *Labeo dero* and *Glossogobius giuris* are specialists in the usage of microhabitat variables in the stream habitat while these are *G. mullya*, *Etroplus maculatus* and *Aplocheilus lineatus* in river habitat. *Danio aequipinnatus* showed extreme variations along focal point velocity variable in both habitats indicating an opportunistic behaviour.

Keywords: Vamanapuram River, fish community, microhabitat breadth, focal point velocity

INTRODUCTION

The ecology of the environment has a bearing on the fish living in it. The fish acquires specialization of varying degrees in the environment and the nature of specialization depends upon the competition between the fish species. From the head to the mouth of a river, the habitats and characteristics vary and the degree of adaptations the fish community acquires depends upon the resources available. Moreover, microhabitat plays an important role in structuring the fish community of the rivers. The major microhabitat resources on which fish segregate can be grouped as depth of water column, flow rate or velocity and substrate. The present study aimed to analyse the utilization of microhabitat variables by the fish species in the riverine environment. The study will help to understand the utilization of various niche/microhabitat resources in the river. The study will also bring to light the generalistic and specialistic modes of microhabitat utilization by the fish community.

MATERIAL AND METHODS

Vamanapuram River is a small river which forms the lower course of Kallar River originating from the Chemmungi Mottai at about 1860 m above MSL in Western Ghats (Fig. 1). The river has a length of 88 km, with a drainage area of 687 km^2, which lies entirely within Kerala state. The annual runoff has been assessed as 889 mm (Anon, 1974). The microdistribution of fish species was studied along 12 transects in the river. The abbreviations of the different fish species are furnished in Appendix - 1.

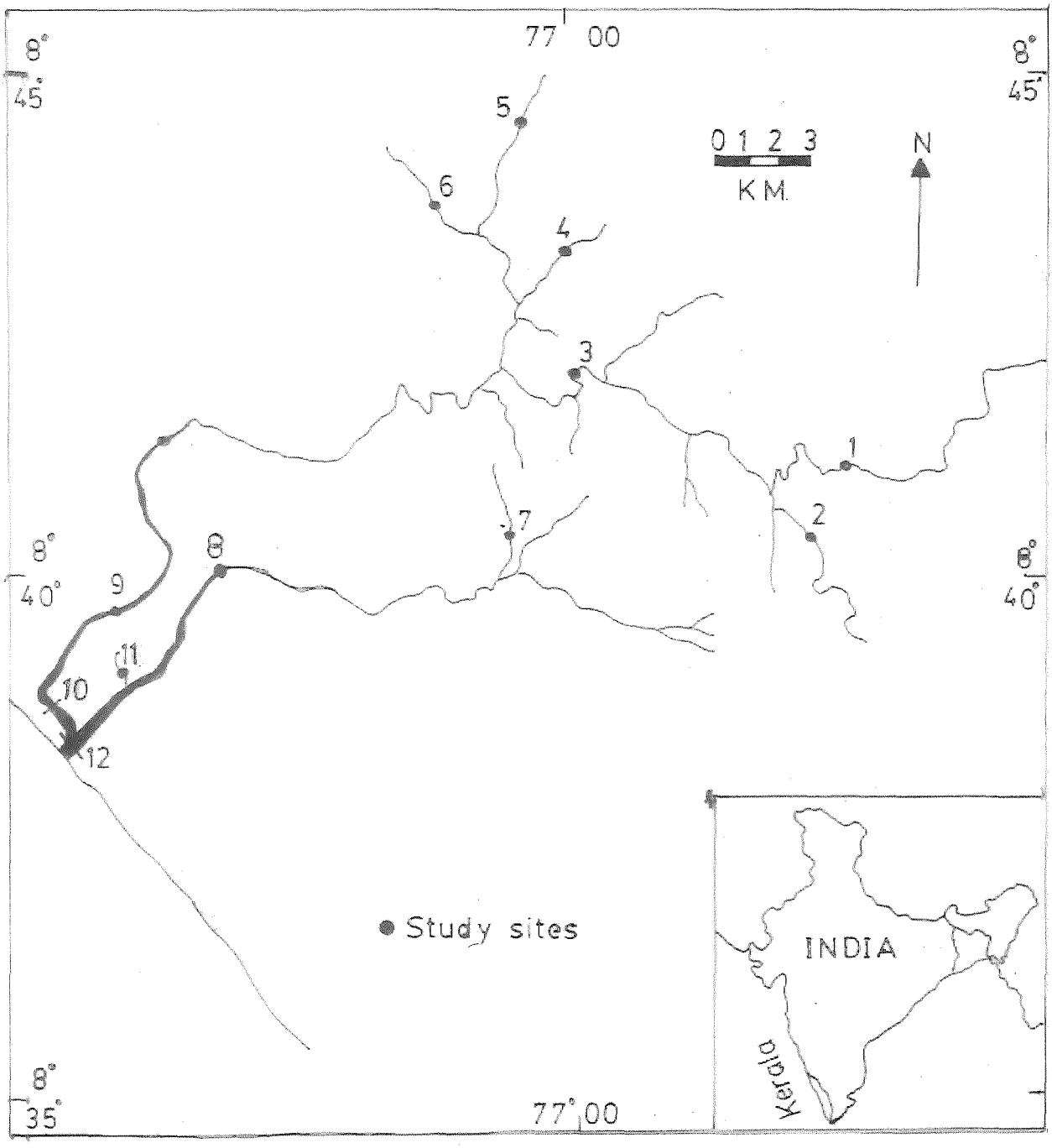

Fig. 1: Location of study sites in Vamanapuram River

APPENDIX - 1

AL	*Aplocheilus lineatus*
AP	*Amblypharyngodon microlepis*
BB	*Barilius bakeri*
DA	*Danio aequipinnatus*
EM	*Etroplus maculatus*
GG	*Glossogobius giuris*
GM	*Garra mullya*
LD	*Labeo dero*
MA	*Mystus armatus*
PA	*Puntius amphibius*
PF	*P. filamentosus*
PM	*P. melanampyx*
PS	*P. sarana*
PT	*P. ticto*
PV	*P. vittatus*
RD	*Rasbora daniconius*
XC	*Xenentodon cancila*

The variables studied were relative depth, focal point velocity, water column depth, velocity and substrate. Observations were made for 7404 specimens representing 17 species. Twelve stations representing stream and river habitats available in the river were selected for the study. Each station was sampled at least five times during the study period. Microhabitat observations were made visually from the shore or taken from their position in the nets depending on the habitat. Each fish was measured for the following microhabitat variables:

Position in the water column which gives the relative depth of the fish, *i.e.*, distance from surface in relative scale 0.00 to 1.00 like surface (0.00), high (0.01 to 0.25), middle (0.26 to 0.75), low (0.76 to 1.00) and bottom (1.00).

Focal point velocity is the velocity at the position of the fish. Focal point velocity was estimated for each and every fish individually depending on the position in the water column and the water column depth.

Water column depth is the depth of water at the point where the fish was located.

Mean water column velocity is the velocity at 60% depth if the depth is less than 75 cm or the average of velocities at 20 and 80% of the depth if the water is >75 cm deep (Bovee and Milhous, 1978).

The substrate composition was taken from an area of 0.0625 m directly below the fish and the categories were based on Wentworth particle scale (Moyle and Senanayake, 1984), *i.e.*, (1) detritus, (2) mud, (3) silt, (4) sand, (5) gravel, (6) cobble, (7) boulder and (8) bed rock.

The microhabitat observations along stream habitat were made from a limited area of the study section, which consistently represented the whole profile of the study site. In river habitat, observations were made both visually as well as from the nets. Visual observations were made from the shore up to the depth of visibility and beyond that, the data were collected from the nets. In most of the places, the depth of the water column exceeded the width of

the net (1.00 m). In such conditions, nets were operated twice, one in the water column region and another in the bottom region. The absolute depth of the water column and position of the fish in the nets were taken into consideration while calculating the microhabitat variables. Monofilament gill nets varying in mesh size from 6 to 25 mm were used to catch the fish. First, the nets were spread in the water and made in a vertical position as far as possible. Whenever the position of the net is not vertical, the data were excluded for microdistribution. Each fish observed directly (visual) or from the gill nets had all microhabitat variables read either directly or indirectly through charts. From the microhabitat observations, breadth (B) was calculated for relative depth, focal point velocity, water column depth, water column velocity and substrate for each species. The microhabitat breadth was calculated using the formula of Levins (1968):

$$B = 1 / P_{ij},$$

where P_{ij} is the proportion of the resource in each category.

High breadth values show a generalistic mode of utilization and low values indicate more specialistic nature.

RESULTS AND DISCUSSION

Microhabitat breadth explains the spectrum or range of a particular variable associated with the fish. The breadth observed for the fish community in Vamanapuram River showed that fishes used a narrow spectrum of relative depth resource (Table 1). The maximum breadth observed was for PF (3.95). GM was very particular in its relative depth utilization with a breadth of 1.50 which is very narrow. The focal point velocity variable showed that most of the species used a narrow range of this variable. The highest breadth observed was for PF (2.15). The breadth of mean water column velocity was also narrow with the highest being 1.79 (PF). The breadth of the substrate variable shows that most of the fishes are specific to a particular substrate and deviation from this is very rare. The maximum breadth observed was for PV (3.94).

Table 1: Microhabitat breadth of fish species in Vamanapuram River

Species	Relative depth	Focal point velocity	Water column depth	Mean water velocity	Substrate
PA	3.02	1.08	2.73	1.24	2.06
PF	3.95	2.15	3.17	1.79	2.10
DA	2.75	1.46	2.36	1.20	2.37
RD	3.60	1.29	1.54	0.88	2.30
PT	2.98	1.34	2.22	1.42	2.59
PV	2.95	1.00	1.94	1.00	3.94
PM	2.96	1.00	2.49	1.00	2.15
GM	1.50	1.00	2.07	1.22	1.91
PS	2.42	1.00	2.38	1.00	1.33
BB	2.84	1.18	2.69	1.00	1.99
EM	3.09	2.00	2.07	1.00	2.02
MA	2.33	1.00	3.14	1.00	1.91
AP	3.00	1.00	1.44	1.00	1.95
LD	2.14	1.39	1.68	1.17	1.98
AL	2.04	1.00	1.26	1.00	2.04
GG	1.79	1.00	1.50	1.00	2.00
XC	3.07	1.79	1.91	1.70	1.32
NRS	5	3	5	2	8

NRS – Number of resource states

The microhabitat breadth observed in stream habitat (Table 2) showed that most of the fishes used a narrow range of the microhabitat variables. The breadth calculated for relative depth variable showed that PF was using almost all the positions in the water column with the highest breadth of 3.92. Conversely, LD, GG and GM were very specific in their position in the water column with their breadth being 1.00, 1.00 and 1.30, respectively. The breadth calculated for the focal point velocity variable was narrow ranging from 1.00 to 2.05. The highest breadth value was associated with PF. BB had a breadth value of 1.96. The breadth of water column depth dimension showed variations among the species and the highest breadth was observed in PF as 4.17. MA had a breadth of 3.14. The lowest breadth was observed in GG (1.00). A very narrow breadth was observed for the variable mean water velocity. XC had the highest breadth of 1.79. The breadth calculated for the substrate dimension showed that PV experienced the highest breadth with 3.94. LD and GG had the lowest breadth values of 1.00.

The river habitat experienced variations in the breadth of the different microhabitat dimensions (Table 3). The

Table 2: Microhabitat breadth of fish species along the stream habitat of Vamanapuram River

Species	Relative depth	Focal point velocity	Water column depth	Mean water velocity	Substrate
PA	3.06	1.02	2.92	1.13	2.00
PF	3.92	2.05	4.17	1.63	2.08
DA	2.75	0.13	3.20	1.08	2.43
RD	3.60	1.03	1.07	1.00	2.30
PT	2.93	1.49	2.82	1.42	2.70
PV	2.95	1.00	1.94	1.00	3.94
PM	2.96	1.00	2.49	1.00	2.19
GM	1.30	1.00	1.99	1.13	2.56
PS	2.37	1.00	2.38	1.00	1.33
BB	2.79	1.96	2.59	1.00	2.04
EM	2.96	1.79	2.35	1.00	1.96
MA	2.33	1.00	3.14	1.00	1.91
AP	3.02	1.00	1.44	1.00	1.95
LD	1.00	1.00	1.32	1.00	1.00
AL	2.17	1.00	1.52	1.00	1.52
GG	1.00	1.00	1.00	1.00	1.00
XC	3.02	1.00	2.03	1.79	2.27
NRS	5	3	5	2	8
X	2.60±0.80	1.15±0.44	2.26±0.62	1.13±0.24	2.07±0.67

NRS – Number of resource states

Table 3: Microhabitat breadth of fish species along the river habitat of Vamanapuram River

Species	Relative Depth	Focal Point Velocity	Water Column Depth	Mean Water Velocity	Substrate
PA	2.48	1.17	2.55	1.63	2.27
PF	3.93	1.92	3.24	1.92	2.04
DA	2.11	1.98	1.51	1.47	1.42
RD	2.00	1.00	2.00	1.00	1.79
PT	2.58	1.00	1.63	1.00	1.10
GM	1.63	1.00	2.15	1.60	2.27
BB	2.67	1.92	2.78	1.60	1.79
EM	1.79	1.60	1.79	1.00	2.00
LD	2.88	1.42	2.04	1.20	2.89
AL	1.00	1.00	1.00	1.00	1.00
GG	2.00	1.00	2.00	1.00	1.00
XC	2.00	2.00	1.79	1.60	1.60
NRS	5	3	5	3	8
X	2.26±0.70.	1.42±0.42	2.04±0.57	1.34±0.32	1.76±0.55

NRS – Number of resource states

breadth of relative depth variable was varying between 1.00 (AL) and 3.93 (PF) for the different species. A maximum breadth of 2.00 was observed in XC for the variable focal point velocity. DA experienced a breadth of 1.98 and PF 1.92. Variations in the breadth of water column depth were marked with PF showing the highest breadth values (3.24) and AL the minimum (1.00). The breadth of mean water velocity variable did not show much variations and the maximum value was observed for PF (1.92). The substrate breadth showed variations between 1.00 and 2.89. The maximum value was associated with LD.

Based on the microhabitat breadth in stream habitat, PF was utilizing a wide spectrum of various microhabitat resources available. Among the five microhabitat dimensions studied, PF had the highest breadth in three dimensions. On the basis of relative depth, PF was utilizing almost all the positions in the water column. LD, GG and GM had very narrow range of usage of the water column. The dimensions like focal point velocity and water column depth were also broadly utilized by PF. In mean water velocity, PF was in the second position (1.63) next to XC (1.79). In substrate variable, utilization was comparatively narrow (2.08). Among the 17 species studied in this habitat, GG had the narrowest utilization of various microhabitat dimensions. It was confined to the bottom region along the sand substrate. Its breadth was 1.00 in all the microhabitat variables. Comparatively, LD utilized a narrow range of microhabitat resources. In the present study, the breadth of GM, GG and LD was more towards a specialistic mode.

The distribution of fish along the water column depth variable showed that the fishes were utilizing the shallow region of the river explaining the territorial behaviour of the fish species. This may also be due to riparian vegetation and availability of more food along the shallow region. Vamanapuram River is small (length 88 km) and its fishery is not important economically. Moreover, during the pre-monsoon dry season, some of the sampling stations were disconnected from the main channel forming pool like habitats.

According to Moyle and Senanayake (1984), based on relative depth variable, species with breadth values of less than 2.00 are bottom or surface oriented fishes while those with greater than 4.40 are fishes that use most of the water column. Based on this, in the present study, GM, LD and GG are specialists in streams while GM, EM and AL are those in river habitat.

The breadth for focal point velocity was narrow in streams and the most specialistic species is DA which had a breadth value of 0.13. This species was observed in high velocity regions and swimming against the current most of the time. Such low breadth was also observed in the Kallar stream pools by Arunachalam *et al.* (1988) and in Kallar River by Arun (1992). This species

showed high breadth values for focal point velocity in river habitat (1.98) showing a generalistic mode. Such extreme variation in between the habitats indicates the opportunistic behaviour of the species.

From the mean microhabitat breadth values, it could be concluded that PF is a generalist in microhabitat utilization along stream as well as river habitats. The extreme specialistic fish species were GG in stream and AL in river. PA showed least variations in breadth values between habitats and LD had major difference in mean breadth values. Comparing the mean values, extreme variation was observed for four species, *viz.*, PT, LD, AL and GG. These species are opportunistic in character and they are capable of utilizing the available resources without much specialisation. Among these four species, LD is highly opportunistic and flexible in microhabitat utilization.

Among the five microhabitat variables studied in Vamanapuram River, high degree of resource utilization was observed for relative depth variable in stream and river habitats. This is clearly evident from the high mean values obtained for this variable. Thus, separation within the relative depth variable was very effective in spatial partitioning arrangement for the Vamanapuram River fish assemblage.

Studies on the tropical fish communities in rainforest streams of Sri Lanka by Moyle and Senanayeke (1984) in terms of microhabitat breadth is comparable to the present study. However, the resource states selected by them were more (11) when compared to the present study (5).

In temperate Californian streams, Moyle and Vondrecek (1985) observed that each group had a relatively narrow breadth in at least one dimension compared to most of the other species. In the Black Creeks of Mississippi River (USA), Baker and Ross (1981) observed that the cyprinids utilize the water column dimension more effectively than other variables.

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