

A Comparative Study on The Diversity of Ornamental and Foodfishes of River Achenkovil In Relation to Various Physico-Chemical Characteristics



Zoology

KEYWORDS : Endemism, Achenkovil river, Ichthyofauna, Biodiversity monitoring.

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ABSTRACT

Fish: as the keystone species, assemblage structure and function are crucial for effective assessment and monitoring of rivers. Fish and surface water samples were collected seasonally from three sites of Achenkovil River during September 2010- August 2011. Identification was done using standard keys and physico-chemical and statistical analysis were done using standard procedures. 76 fish species belonging to 22 families were collected, of which 44 were ornamental & 32 were food fishes, 12 endangered, 13 vulnerable, and 2 critically endangered according to IUCN norms. 12 species endemic to Western Ghats and 5 endemic to Kerala. Cyprinidae recorded dominant. Downstream is more diverse. PCA showed that physico-chemical parameters influence the diversity and distribution of the fishes. This data acts as a decision making tool for continuous biodiversity monitoring, conservation of germplasm, declaration of aquatic sanctuaries, protection of endangered species and mitigation of anthropogenic activities.

INTRODUCTION

Fishes are paraphyletic collection of taxa which plays significant role in world's biodiversity. The various fish group account for about half the total number of vertebrates i.e. about 32,500 species. Of these about 500 species are primary fresh water fish with around 65% endemic, cloistered in the two hotspots of India, the Western Ghats and the North East. The Achenkovil River, a freshwater perennial lotic system of the southern Western Ghats is formed by the confluence of several small streams like kallara, kanayar, chittar and kakkadyar originating from the hills of Rishimala, Pasukidamettu and Ramakkaltheri in eastern Kerala. The Achankovil Reserve Forests (900'N- 908'N, 7700'E-77015'E) lies in the proximal drainage area of Achankovil River. This river with about 130km length has a catchment area of 1484 Km². The freshwater ecosystems of Western Ghats with their patchy nature and environmental characteristics support allopatric speciation leading to exceptional fish diversity and yet so endemic and threatened. Information about the biodiversity of Achenkovil river system is provided to an extent for several studies[1,2,3]. Unsustainable development policies, unsound planning, human greed and the desire for material comforts have combined together to create this precarious situation. The ichthyofaunal diversity is depleting alarmly due to introduction of exotic species and various anthropogenic activities. For harnessing the aquatic resources, a scientific understanding of the fish species with respect to their morphological, biological and adaptive characters along with their natural distribution is imperative to back up their optimum exploitation. In this context it is aimed at monitoring and comparing the biodiversity of ornamental and food fish of river Achenkovil in relation to various physico-chemical characteristics thereby evaluating the fish species, taking into consideration riverine health and makes the people more aware about their local environment and its conservation for their existence.

MATERIALS AND METHODS

1. STUDY AREA: The study area is selected from both Pathanamthitta (Achenkovil and Pandalam) and Alleppey (Veeyapuram) districts as Achenkovil river flows through it.

Site I: Achenkovil which includes Manalar waterfalls and Avanippara.

Site II: Pandalam which includes Koyikkal kadavu and Madathil kadavu.

Site III: Veeyapuram.

II. SAMPLE COLLECTION: Fish and surface water samples were collected seasonally from three sites of Achenkovil River during September 2010- August 2011. Sampling was done using cast nets, scoop nets, drag net, gillnet and traps with the help of professional fishermen. Fish samples collected were packed in separate polythene bags labeled with place and date of collection and vernacular name of each species and stored in freshly prepared 5 % formaldehyde pending laboratory analysis. Species level identification was done using standard keys [4, 5, 6, 7]. Surface water samples for physico-chemical analysis were collected in 1L sterilized plastic bottles and physico-chemical variables such as Light, Temperature, DO, pH, Salinity, Hardness, Primary productivity, Nitrate and Phosphate content were analyzed using standard procedures[8].

III. STATISTICAL ANALYSIS

The software "Biodiversity Professional" was used to calculate the site wise variation in the Piscian diversity, dominance, abundance, richness, evenness distribution and principal component analysis. The significance of data was determined with analysis of variance (ANOVA).

RESULTS AND DISCUSSION

The present study indicates that the fish fauna of the river Achenkovil composed majorly of Cyprinids that are common to those in many Southeast Asian riverine ecosystems which correlates with the work of Bhatt[9]. 76 fish species belonging to 22 families and 7 orders were collected and identified from the study area, of which 44 ornamental and 32 edible fishes. Family Cyprinidae recorded dominant with 31 species in which 23 ornamental and 8 edible. Among Cyprinidae, 3 ornamental fishes found to be EWG whereas 3 species found to be endangered and endemic to Kerala (Table 1). *Osteobrama bakerii* (EN), *Dayella malabarica* found to be critically endangered whereas *P. jerdoni* and *P. vittatus* were vulnerable. *Gonoproktopterus curmuca* (EWG), *Labeo dussumeiri* (EN) and *Catla catla*, *P. sarana subnasutus*, *Tor khudree* (VU) were included in food fishes. Family Bagridae represents 11 species of which 2 ornamental and 9 edible. Among ornamental fishes *Batasio travancoria* (EN), *Horobagrus brachysoma* (EN, EK), *Mystus malabaricus* and *M. punctatus* (EN, EWG). *Cichlidae* represents 3 species of which *Oreochromis mossambicus* is the only exotic representative in food. *Etroplus maculatus* is the only ornamental representative. *Channidae* represents 3 edible species of which *Channa gachua* is vulnerable. *Balitoridae* represents 3 ornamental loaches endemic to Western Ghats, *Bhavana australis*, *Mesonemacheilus guentheri* and *M. triangularis*.

Table 1. Present status of fish species collected from Achenkovil river.

Sl. no.	FAMILY	SPECIES	ORNAMENTAL/ FOOD FISH	IUCN STATUS
1	Cyprinidae	<i>Amblypharyngodon microlepis</i>	Ornamental	LRnt
2		<i>Barilius bakeri</i>	Ornamental	LRnt EWG
3		<i>Barilius canarensis</i>	Ornamental	LRnt EWG
4		<i>Barilius gatensis</i>	Ornamental	LRlc EWG
5		<i>Catla catla</i>	Edible	VU
6		<i>Chela fasciata</i>	Ornamental	EN EK
7		<i>Cyprinus carpio</i>	Edible	LRlc
8		<i>Danio aequipinnatus</i>	Ornamental	LRlc
9		<i>Danio malabaricus</i>	Ornamental	LRlc
10		<i>Dayella malabarica</i>	Ornamental	CR
11		<i>Garra mullya</i>	Ornamental	LRlc
12		<i>Garra surendranathanii</i>	Ornamental	EN EK
13		<i>Gonoproktopterus curmuca</i>	Edible	EN EWG
14		<i>Labeo dussumeiri</i>	Edible	EN
15		<i>Labeo rohita</i>	Edible	LRlc
16		<i>Puntius amphibius</i>	Ornamental	LRlc
17		<i>Puntius bimaculatus</i>	Ornamental	LRlc
18		<i>Puntius carnaticus</i>	Edible	LRnt EWG
19		<i>Puntius chalakkudiensis</i>	Ornamental	EN EK
20		<i>Puntius denisonii</i>	Ornamental	EN EK
21		<i>Puntius fasciatus</i>	Ornamental	LRnt
22		<i>Puntius filamentosus</i>	Ornamental	LRlc
23		<i>Puntius jerdoni</i>	Ornamental	VU
24		<i>Puntius sarana subnasutus</i>	Edible	VU
25		<i>Puntius sophore</i>	Ornamental	LRnt
26		<i>Puntius ticto</i>	Ornamental	LRlc
27		<i>Puntius vittatus</i>	Ornamental	VU
28		<i>Rasbora daniconius</i>	Ornamental	LRnt
29		<i>Salmostoma boopis</i>	Ornamental	LRlc
30		<i>Tor khudree</i>	Edible	VU
31		<i>Osteobrama bakeri</i>	Ornamental	EN
32	Bagridae	<i>Horobagrus brachysoma</i>	Edible	EN EK
33		<i>Batasio travancoria</i>	Ornamental	EN
34		<i>Mystus armatus</i>	Edible	LRlc
35		<i>Mystus cavasius</i>	Edible	LRnt
36		<i>Mystus gulio</i>	Edible	LRlc
37		<i>Mystus malabaricus</i>	Edible	EN EWG
38		<i>Mystus menoda</i>	Edible	LRlc
39		<i>Mystus vittatus</i>	Edible	LRlc
40		<i>Mystus oculatus</i>	Ornamental	LRlc
41		<i>Mystus montanus</i>	Edible	LRlc
42		<i>Mystus punctatus</i>	Edible	EN EWG
43	Cichlidae	<i>Etroplus maculatus</i>	Ornamental	LRlc
44		<i>Etroplus suratensis</i>	Edible	LRlc
45		<i>Oreochromis mossambicus</i>	Edible	EX
46	Channidae	<i>Channa marulius</i>	Edible	LRnt
47		<i>Channa striatus</i>	Edible	LRlc
48		<i>Channa gachua</i>	Edible	VU
49	Balitoridae	<i>Bhavana australis</i>	Ornamental	LRnt EWG
50		<i>Mesonemacheilus guentheri</i>	Ornamental	LRlc EWG
51		<i>Mesonemacheilus triangularis</i>	Ornamental	LRnt EWG
52	Siluridae	<i>Ompok bimaculatus</i>	Edible	VU
53		<i>Wallago attu</i>	Edible	LRnt
54	Mastacembelidae	<i>Macragnathus guentheri</i>	Edible	VU
55		<i>Mastacembelus armatus</i>	Edible	LRlc

56	Ambassidae	Chanda nama	Ornamental	LRlc
57		Parambassis dayi	Ornamental	VU EWG
58		Parambassis thomassi	Ornamental	LRnt
59		Parambassis ranga	Ornamental	LRlc
60		Pseudambassis baculis	Ornamental	LRlc
61	Hemiramphidae	Hyporhamphus limbatus	Edible	LRlc
62		Hyporhamphus xanthopterus	Ornamental	LRlc
63	Belonidae	Xenentodon cancala	Edible	LRlc
64	Belontiidae or Osphronemidae	Pseudosphromenus cupanus	Ornamental	LRlc
65	Cobitidae	Lepidocephalus thermalis	Ornamental	LRlc
66	Aplocheilidae	Aplocheilus lineatus	Ornamental	LRlc
67	Clariidae	Clarias batrachus	Edible	LRlc
68	Anguillidae	Anguilla bengalensis	Edible	EN
69	Heteropneustidae	Heteropneustes fossilis	Edible	VU
70	Anabantidae	Anabas testudineus	Ornamental	VU
71	Gobiidae	Glossogobius giuris	Edible	LRlc Estuarine
72	Oryziidae	Oryzias dancena	Ornamental	LRlc
73	Nandidae	Nandus nandus	Ornamental	LRnt
74		Pristolepis marginata	Ornamental	VU
75	Tetraodontidae	Tetraodon travancoricus	Ornamental	VU
76	Sisoridae	Glyptothorax anamalaiensis	Ornamental	CR EWG

EWG- Endemic to Western Ghats

EK- Endemic to Kerala.

EX- Exotic

EN-Endangered

CR- Critically endangered

VU- Vulnerable

LRnt- Low risk nearly threatened

LRlc-Low risk least concern

Siluridae and Mastacembelidae represent 2 edible species of which *Ompok bimaculatus* and *Macrognathus guentheri* are vulnerable. Ambassidae represents 5 ornamental species of which *Parambassis dayi* (EWG) is vulnerable. Hemiramphidae represents 1 ornamental and 1 edible species. Belonidae represents 1 edible species,

Belontiidae or Osphronemidae represents single ornamental species, Cobitidae represents single ornamental species, Aplocheilidae represents single ornamental species and Family Clariidae represents 1 edible species. The migratory *Anguilla bengalensis*, single edible species of Anguillidae is found to be endangered. *Heteropneustes fossilis* (VU) is the only edible fish in Heteropneustidae. *Anabas testudineus* of Anabantidae is found to be a vulnerable ornamental fish. *Glossogobius giuris* of Gobiidae is the only estuarine edible species collected from the river. Oryziidae represents single ornamental species. Nandidae represents 2 ornamental species of which *Pristolepis marginata* is vulnerable. *Tetraodon travancoricus* (VU), the puffer ornamental fish of Tetraodontidae. *Glyptothorax anamalaiensis* (EWG) of Sisoridae is the ornamental species which is Critically endangered.

Table 2. Biodiversity indices of Ornamental and Food fishes collected from Achenkovil river.

BIODIVERSITY INDICES	ORNAMENTAL FISHES			FOOD FISHES		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Shannon Weiner Index (H')	1.539	1.534	1.534	1.463	1.452	1.463
Simpsons Diversity Index(1/D)	29.645	29.35	29.313	27.087	26.299	27.266
Hill's Abundance Number (H0)	44	43	44	32	32	32
Margaleff's Richness Index (M)	12.794	12.798	12.828	10.571	10.633	10.537
Mackintosh Distance Index (U)	0.185	0.262	0.321	0.195	0.278	0.339
Mackintosh Evenness Index (E)	1.177	1.177	1.177	1.214	1.214	1.214

Various biodiversity indices were tabulated in table 2. The Shannon-Weiner diversity index (H') and Simpsons Dominance index (D) values for ornamental fishes is highest in the Site I Achenkovil followed by Site II Pandalam and Site III Veeyapuram. Hill's Number (H0) shows that Site I and Site III possess most abundance (44) while least abundance was reported in site II (43). The Mergaleff richness index (M) is high in Veeyapuram (12.828) followed by Pandalam (12.798) and Achenkovil (12.794). For food fishes the Shannon-Weiner diversity index (H') and Simpsons Dominance index (D) value were highest in the Site I Achenkovil and Site III Veeyapuram followed by Site II Pandalam. Hill's Number (H0) shows that all Sites possess moderate abundance of food fish species. The Mergaleff species richness index (M) is high in Pandalam (10.633) followed by Achenkovil (10.571) and Veeyapuram respectively (10.537). Mackintosh Distance (U) and Mackintosh species Evenness (E) value showed that both ornamental and food fishes possess only a narrow range of distribution and they

are not evenly distributed in these sites. All numerical values in the present study were significant at P<0.05 level.

Table 3. Mean value of Physico-chemical parameters along different sites of Achenkovil river

Physico-chemical parameters	Site I M±SE	Site II M±SE	Site III M±SE
Light	1.45±0.01	0.54±0.31	0.37±0.04
Temperature	23.5±0.3	28.72±0.7	29.73±0.1
pH	6.9±0.1	7.17±0.01	7.21±0.3
Dissolved oxygen(DO)	7.51±0.1	6.57±0.32	6.36±0.4
Hardness	35.67±0.05	24.33±0.21	28.00±0.11
Salinity	0.00±0.2	0.00±0.2	0.97±0.12
Phosphate	0.25±0.12	0.31±0.13	0.47±0.3
Nitrate	0.21±0.05	0.16±0.23	0.25±0.23
1° productivity	0.63±0.02	8.51±0.42	23.00±0.01

The present study of physico-chemical analysis of river water (Table 3) shows level of light penetration at a range of 1.4-0.37, highest at site I, Achenkovil. Light penetration of water is important as it is related to system productivity through wind, current, turbidity and absorption loss due to various suspended and colloidal particles. Water temperature ranges 23.5-29.73, highest at site III, Veeyapuram. Temperature is a factor controlling the activities and distribution of living organisms. pH ranges from 7.21-6.90, highest at site III, Veeyapuram. pH is the prime factor where most organisms do not withstand abrupt changes. DO is highest at site I, Achenkovil with a range of 7.51-6.36. Fluctuation in dissolved oxygen is due to primary productivity of water. Salinity recorded 0.97 at Veeyapuram. Hardness ranges 35.67-24.33, highest at Achenkovil. Nitrate (0.25-0.16), Primary productivity (23.00-8.51) and Phosphate (0.41-0.25) were highest at site III. Low phosphate value at site I indicates non polluted nature of river origin. The study explains that water quality parameters have influence in the diversity and distribution of fishes at river Achenkovil. Principle component analysis (PCA) of the category multivariate analysis was employed to find out the principle factors in water affecting the distribution of fishes. Principal component analysis indicate that Dissolved oxygen is the principal component affecting the density and diversity of fish. Nitrate is the second principal component and pH is recorded the third principal component (Table 4).

Table 4. Principle component affecting the distribution of Ichthyofaunal diversity of River Achenkovil

FACTOR	EIGENVALUE	SCOREVALUE	PROPORTIONS
DO	0.40729	3.27001	5.97287
NITRATES	0.40616	-4.18825	3.02713
pH	0.33976	-3.21614	0

Achenkovil river of Kerala is not frequently monitored for studying current ecological status or surveying the major component of its biodiversity, the fishes. Upstream of the river is rich in ornamental species whereas both upstream and downstream exhibit moderate diversity of food fishes. The presence of exotic fish *Oreochromis mossambicus* is a matter of concern to the riverine fish stock which will be a threat to native stock of orange chromide *Etroplus maculatus*[10]. The study also indicates range extension of *P.chalakkudiensis* to the Achenkovil river system[3]. Extent of pollution is high at Pandalam due to domestic, urban sewage and runoff from agricultural fields, which led to water quality deterioration which may cause fish mortalities and toxicity to organisms prevails. Unscientific sand mining resulted in the destruction of feeding and breeding grounds of fishes apart from reducing the self cleaning capacity of river water. In this context the existence of many endemic, endangered and vulnerable species in the river arise the importance of the continuous biodiversity monitoring and conservation of river Achenkovil. Kerala's future depends on the evolution of a development model that recognizes that conserving rivers amounts to conserving life itself. So it is inevitable to identify ways to protect and revive the State's life-giving rivers.

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