

Bi-Seasonal Variation in the Piscian Diversity In Relation To Physico-Chemical Parameters of Pallickal River-Kerala, India

V. Jayalekshmy and M.G. Sanalkumar

P.G. & Research Department of Zoology, N.S.S. College, Pandalam, Pathanamthitta-689501, Kerala, India

Abstract- Kerala is the synonym to biodiversity. Fresh water ichthyological diversity is the most crucial part of biodiversity as it is difficult to be estimated and protected. The study aimed to estimate the fish diversity of Pallickal River in relation to physico chemical parameters. The period of study was from March 2012 to October 2012. Fish samples and surface water samples were collected seasonally. Specimens were preserved in 4% formalin. Identification of fishes was done with standard keys and water samples were analyzed by standard procedures. Statistical analysis of the data was done. 30 fishes belongs to 16 families of 9 orders were obtained, in which the dominant family was Cyprinidae. One endangered species and 7 vulnerable species were recorded during the study. Biodiversity indices were calculated using Biodiversity pro and the values obtained showed rich and healthy ecosystem showing less over dominance and high diversity. Dominant species differed in relation to site and season. Physico chemical parameters indicated the ecosystem as a life sustainable one, except low pH recorded at site 1 during pre monsoon period. DO, PH and TDS were identified as the principal factors those influence the piscian fauna, using PCA.

Index terms - Biodiversity, Cyprinidae, Ichthyology, Pallickal River, PCA

I. INTRODUCTION

Earth is the blue planet, which holds the precious matter of the Universe, Water. 2/3 of the Earth's surface is covered with water, comprises both marine and fresh water ecosystems. Though fresh water habitats occupy a relatively small portion of the earth's surface, their importance to man is far greater than their area because they are the most convenient and cheapest source of water for domestic and industrial needs (Odum, 1971). Both lentic and lotic freshwater ecosystems support plenty of biotic forms from microscopic planktons to higher organisms (Thirumala *et al*, 2011). Among them, some act as the representatives of the ecosystem as their presence, abundance, characters and morphological features can accentuate the environmental parameters of that ecosystem. So, inland waters and fresh water biodiversity constitute a valuable natural resource in economic, cultural, aesthetic, scientific and educational terms (Vijayalaxmi *et al*, 2010).

Rivers of India harbor one of the richest fish genetic resources on the world (Vass *et al*, 2009). Kerala is rich with 44 short and swift flowing perennial rivers, originating from

Western Ghats, the hot spot of biodiversity. Fresh water ichthyological diversity is the most crucial part of biodiversity as it is difficult to be estimated and protected. The potential of fresh water fish extinction tends to concentrate in endemic species rich tropical and subtropical areas mostly due to anthropogenic activities, which led to habitat destruction, pollution, over exploitation, blocking of river flow, and other environmental problems like acid raining, global warming etc. Since the quality of aquatic life depends on the quality of water, fishes have been regarded as effective biological indicators of environmental quality (Bhat, 2003) and anthropogenic stress in aquatic ecosystems.

Pallickal River, one among the 44 major rivers of Kerala, originates from Kuttivanam, a part of Western Ghats, lies at the southern cliffs of Kalaritharakunnu in Adoor (Pathanamthitta) and flows through Nellimukal, Anayadi and Vattakkayal before merging with the Kozhikode canal, near Karunagapally, in Kollam district. It is 42 Km long and holds 220km² area. The two sides of the river show high population density since it flows through rural areas. Though there is enough literature on freshwater biodiversity of Western Ghats in general, there are no published works on the fish diversity of many rivers of Kerala including Pallickal River. The present study aimed to monitor the fish diversity of Pallickal river in relation to physico chemical character of river water, of premonsoon and monsoon seasons and thereby estimating the piscian population health and quality or river water concern to domestic uses of local people.

II. MATERIALS AND METHODS

I STUDY AREA:

a) Site I- Nellimukal: Sampling site at the upstream segment of the river, located at latitude 9^o 05' 06.2 N and longitude 76^o 37' 69.3 E with an elevation of 53 ft above MSL.

b) Site II- Anayadi: Sampling site at the midstream segment of the river, located at latitude 9^o 07' 08.5 N and longitude 76^o 33' 59.2 E with an elevation of 52 ft above MSL.

c) Site III- Vattakkayal: Sampling site at the downstream segment of the river, located at latitude 9^o 01' 21.4 N and longitude 76^o 31' 40.8 E with an elevation of 52 ft above MSL.

II WATER SAMPLING: Surface water samples for physico chemical analysis were collected in 1L sterilized plastic bottles. Fixation of the water sample was done according to APHA water collection techniques. Spot detection of temperature and pH of water was done using portable equipments. Samples were

brought to the laboratory as early as possible and hardness, dissolved oxygen (DO), Total dissolved solids (TDS), Conductivity, free CO₂ and BOD were detected using standard procedures (APHA, 2005).

III COLLECTION OF FISH SAMPLES AND IDENTIFICATION: Fishes were collected with the help of local fishermen, using gill net, cast net, hooks and lines and locally using equipments. Primary identification was done at the site and local names of the fishes were collected from fishermen. Fishes were preserved in 4% formalin. Healthy adults showing taxonomic characters were kept as standard specimens. Identification was done using standard keys of Jayaram(1999) and Easa and Shaji (2003).

IV STATISTICAL ANALYSIS: Statistical analysis of the data obtained has been done and the mean values of the triplicate samples with standard deviation were used for further analysis. The site wise variations in the ecological attributes of piscian population were calculated using the software, Biodiversity pro. Two way ANOVA was done to analyze the significance of variations observed in physico chemical parameters.

III. RESULT AND DISCUSSION

30 fish species belongs to 16 families were collected during the study (table 1) and taxonomic identification and preservation were done. As per IUCN norms for ecological status, 11fishes were identified as 11 endemic to Indian subcontinent, 6 endemic

to India, 8 endemic to Western Ghats and 3 endemic to Kerala. Eight species were identified as vulnerable and one (*Horabagrus brachysoma*) endangered. The abundant genus was Puntius, with six species, Family Cyprinidae, having 10 species and order, Cypriniformes with 11 species of 2 families, followed by Siluriformes and Perciformes. Similar results were obtained for major ichthyological studies done in the rivers of Western Ghats (Bhat, 2003; Kumar et al, 2011; Patra et al, 2011). One esturian species, *Glossogobius giuris giuris*, was collected from Vattakkayal during the monsoon season. Ample collections of Dwarf puffer, *Carinotetraodon travancoricus*, were observed during pre monsoon season and the local people seldom consider it as a fish. Exotic species were not recorded during the study as the introduction of fish seeds were started in three stations of the river from July- August 2012 and the river under study has less connections with the neighboring rivers, Achencovil and Kallada, in the upstream and midstream level. Comparing the two seasons, the highest number of fishes were recorded during the monsoon season in all the sites. During the pre monsoon season, the river water level was too low due to reduction in rainfall at Pathanamthitta and Kollam districts in 2011(273.3mm) as compared to last two years; 313.4mm in 2010 and 407.1mm in 2009. Decline in the water level reduced the accessibility of fishes during collection and will reduce the number and species of fishes in sampling. Onset of monsoon was in late May and the collection of fishes after that showed remarkable increase in diversity and abundance in all three sites. Among the sites, Vattakkayal (PM: 200, M: 448) was observed as more and Nellimukal (PM: 65, M: 123) was less diverse and abundant for ichthyological population.

Table 1: List of fish species collected from Pallickal river

No.	Order	Family	Name of Fish	IUCN status	Endemism
1	CYPRINIFORMES	Cyprinidae	<i>Puntius vitattus</i>	VU	EN-WG
2			<i>Puntius filamentosus</i>		EN-WG
3			<i>Puntius fasciatus</i>		EN-WG
4			<i>Puntius sarana subnsutus</i>	VU	EN-WG
5			<i>Puntius mahecola</i>		EN-IS
6			<i>Puntius ticto</i>		EN-WG
7			<i>Rasbora daniconius</i>		EN-IS
8			<i>Devario malabaricus</i>	VU	EN-WG
9			<i>Garra mullya</i>		EN-I
10			<i>Barilius bakeri</i>	VU	EN-I
11				Cobiitidae	<i>Lepidocephalus thermalis</i>
12	PERCIFORMES	Anabantidae	<i>Anabas testudineus</i>	VU	EN-IS
13		Cichlidae	<i>Etilapia maculata</i>		EN-IS
14			<i>Etilapia suratensis</i>		EN-IS
15		Gobiidae	<i>Glossogobius giuris giuris</i>		EN-I
16		Ambassidae	<i>Parambassis dayi</i>		EN-K
17	SILURIFORMES	Bagridae	<i>Mystus montanus</i>		EN-I
18			<i>Mystus oculatus</i>		EN-I
19			<i>Horabagrus brachysoma</i>	EN	EN-K
20		Heteropneustidae	<i>Heteropneustes fossilis</i>		EN-IS
21		Clariidae	<i>Clarias batrachus</i>		EN-IS

22	BELONIFORMES	Belonidae	<i>Xenentadon cancila</i>		EN-IS
23		Hemirhamphidae	<i>Hyporhambus xanthopterus</i>	VU	EN-I
24	CLUPEIFORMES	Clupeidae	<i>Dayella malabaricus</i>		EN-WG
25	CYPRINODONTIFORMES	Aplocheilidae	<i>Aplocheilus lineatus</i>		EN-IS
26			<i>Aplocheilus blocki</i>		Native
27	ELOPIIFORMES	Megalopidae	<i>Megalops cyprinoides</i>		Native
28	SYNBRANCHIFORMES	Mastacembulidae	<i>Mastacembelus armatus</i>		EN-IS
29			<i>Macrognathus guentheri</i>	VU	EN-IS
30	TETRAODONTIFORMES	Tetraodontidae	<i>Carinotetraodon travancoricus</i>	VU	EN-K

*EN-WG- Endemic to Western Ghats *EN-IS- Endemic to Indian Subcontinent *EN-K- Endemic to Kerala.
*EN-I- Endemic to India. VU Vulnerable. EN Endangered.

Biological indices for each site in two seasons were calculated using Biodiversity pro. The Shannon-wiegner diversity index was high at site 3 Vattakkayal (PM 1.26; M 1.45) in two seasons and low at site 1, Nellimukal (PM & M 1). For site 2, Thengamom, diversity index produced medium values (PM 1.23; M 1.30). All values showed poor fish diversity in the ecosystem and the onset of monsoon had a positive influence on diversity. In pre monsoon collection, Simpson’s dominance index was high at site 1(0.178) and low at site 2(0.085) followed by site 3(0.093) and during monsoon, site 1(0.163) recorded the highest value followed by site 2 (0.094) and site 3 (0.08). As the value reduces, the species diversity increases. Hence during monsoon, vattakkayal and during pre monsoon, Thengamom were estimated as more diverse. All the values lie below 0.5, show the fishes are equally distributed and the chances of presence of an over dominant species is less.

In two seasons, Margalef index of richness values were high at site 1 (PM 1.21; M 1.38) followed by site 2 (PM 1.13; M 1.26) and site 3 (PM 0.96; M 1.09) revealed that the ecosystem is rich in fish population. Values obtained for McIntosh distance

index ranges between 1.048 (for site 3) and 1.134 (for site 1), indicating that the ecosystem provides average space available for each species and hence the species show moderate clustering. K dominance and Hill number of dominance showed that in premonsoon season, 2 species (*Rasbora daniconius* and *Etroplus maculatus*) at site 1, five species (*Etroplus maculatus*, *Clarias batrachus*, *Puntius filamentosus*, *Dayella malabarica* and *Devario malabaricus*) at site 2 and six species (*rasbora daniconius*, *Etroplus maculatus*, *Puntius filamentosus*, *Daverio malabaricus*, *P. fasciatus* and *Xenentadon cancila*) at site 3 were found to be abundant and during monsoon, 2 species (*P. filamentosus* and *Rasbora daniconius*) at site 1, 5 species (*P. filamentosus*, *Rasbora daniconius*, *P. ticto*, *Etroplus maculatus* and *P. mahecola*) at site 2 and 7 species (*Parambassis dayi*, *P. filamentosus*, *Dayella malabaricus*, *E. maculatus*, *P. ticto*, *Carinotetraodon travancoricus* and *R. daniconius*) at site 3 were abundant in the population. Based on the distribution studies, during pre monsoon, 15 species showed random and 8 species showed aggregated distribution and during monsoon, 13 species showed random and 17 species showed aggregated distribution.

Table2: Parameters of Fish diversity in Pallickal River

Biodiversity Indices	Pre monsoon(PM)			Monsoon(M)		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
No. of Fishes obtained	65	87	200	123	203	447
No. of species obtained	10	17	18	10	20	26
Shannon- Weiner index of diversity	1	1.23	1.26	1	1.30	1.45
Simpson’s Dominance Index (D)	0.178	0.085	0.093	0.163	0.094	0.08
Hill’s number of Abundance(H1)	2.09	5.9	6.04	2.42	5.99	7.30
Margalef Index of Species Richness	1.21	1.13	0.96	1.38	1.26	1.09
McIntosh Index of Distance(D)	1.134	1.113	1.073	1.095	1.073	1.048
McIntosh Index of Evenness(E)	1.25	1.26	1.26	1.22	1.22	1.22

The seasonal and site wise variation of nine major hydrological parameters (table 3) and their influence on piscian diversity were also studied using ISO recommended standards of water quality parameters (WHO, 1971) and Principal Component

analysis. The lowest pH value was recorded at site 1(6.46) during premonsoon, which lies below the normal range 6.5-8.5 and all other parameters were within the sustainable range. Minimum temperature was recorded at the downstream site in two seasons.

This may be due to the presence of rich vegetation, which can reduce the water temperature. TDS and conductivity were high during the pre monsoon period (Thirumala *et al*, 2011) and Dissolved Oxygen, hardness and BOD showed significant reduction with the onset of monsoon (Araoye, 2009; Patra et al, 2011 and Mahor, 2010). But salinity showed little fluctuation with the season. Salinity (2ppt) and the presence of *Glossogobius giurus giurus* support to conclude the estuarine

nature of site 3, vattakkayal. Principal Component Analysis, employed to identify the variants which control the piscian population characteristics, showed DO, pH and TDS as the principal factors and less affected by temperature as it has a synergistic effect with other parameters of the ecosystem (Hansson et al, 2012).

Table 3: Physico-chemical parameters along the three different sites in two seasons of Pallickal River

Physico-chemical parameters	Pre monsoon(PM)			Monsoon(M)		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
Temperature(°C)	27.06	26.87	26.13	26.13	26.09	24.87
pH	6.46	6.66	6.8	6.8	6.9	6.96
DO (mg/l)	6.25	6.4	6.6	5.37	5.85	6.17
Hardness(mg/l)	2	1.8	2.3	0.6	0.6	1
Free CO2(mg/l)	1	1	2	1	2	1
Conductivity(µmhos/cm)	75.2	82.5	90.9	63.6	60.1	79
Salinity(ppt)	0.1	0.1	0.2	0.1	0.1	0.2
BOD(mg/l)	2.1	1.8	0.67	1.15	1.32	1
TDS(ppt)	53.3	68.2	73.23	42.17	40.63	64.17

IV. CONCLUSION

The database of fish diversity in relation to physic chemical properties of water of Pallickal River is essential to implement conservational and utilitarian programmes and to record the genetic diversity of the river as a part of freshwater ecosystems of Kerala. The data obtained can be primarily utilized for recording the biodiversity of the river, as a part of Western Ghats, one of the Hotspots Biodiversity, since less scientific studies had been done about the health of this riparian system.

REFERENCES

[1] A. Bhat, "Diversity and composition of Freshwater fishes in river systems of Central Western Ghats, India." *Env. Biology of Fishes*. 2003, 68, pp25-38.
 [2] A.K.Patra, S. Sengupta, and T.Datta, "Physico chemical properties and ichthyofauna diversity in Karala River, a tributary of Teesta river at Jalpaiguri district of West Bengal, India", *Int. J. Apl. Bio. Pharmaceutical tech.* 3rd Ed. Vol.2, pp.47-58.
 [3] APHA. "Standard methods for the examination of water and waste water". American Public Health Association. 21st ed. Washington D C, 2005, pp9-48.
 [4] C.R.R.Kumar, M. Harikrishnan and B.M.Kurup, "Exploited fisheries resources of the Pampa River, Kerala, India", *Indian J. Fish.* 3rd ed. Vol.58, pp.13-22.
 [5] C.Vijayalaxmi, M. Rajashekhar and K.Vijayakumar, " Fresh water fishes distribution and diversity status of Mullameri River, a minor tributary of Bheema River of Gulbarga District, Karnataka", *Int. J. Systems Biology*. 2nd Ed. Vol.2, 2010, pp.01-09
 [6] K.C.Jayaram, " The Freshwater Fishes of Indian Region", Narendra Publishing House, Delhi, India, 1999, 551pp.

[7] K.K.Vass, S. Samanta, V.R. Suresh, P.K. Katiha, and S.K. Mandal, " Current status of river changes", Central Inland Fisheries Research Institute. Barrackpore. Bulletin No.152, 2008.
 [8] L.A.Hansson, A.Nicolle, W.Graneli, P. Hallgren, E. Kritzbeg, A. Persson, J. Bjork, P.A. Nilsson and C.Bronmark, "Foodchain length alters community responses to global change in aquatic systems". *Nature: climate change*. 2012, PP.1-6.
 [9] P.A. Araoye, "The seasonal variation of pH and dissolved oxygen (DO₂) concentration in Asa lake iiorin, Nigeria", *Int. J. Physical Sciences*. 2009, 5th ed. Vol.4, pp 271-274.
 [10] P.E.Odum, "Fundamentals of Ecology", Saunders International Student Edition, 1971, 3rd ed.
 [11] P.S.Easa, and C.P.Shaji, "Biodiversity documentation for Kerala, 8: Freshwater fishes", Kerala Forest Research Institute. India, 2003, 126pp.
 [12] S.Thirumala, B.R. Kiran and G.S.Kantaraj, " Fish diversity in relation to physic chemical charecteristics of Bandra reservoir of Karnataka, India", *Advances in Apl. Research*, 5th Ed. Vol.2.2011, pp.34-47
 [13] WHO, "Standards for Drinking Water", Third Ed., World Health Organization, Geneva, 1971.

AUTHORS

First Author – V. Jayalekshmy, M.Sc., Research Scholar, Post Graduate and Research Department of Zoology, N.S.S. College, Pandalam, Kerala, India. lekshmi.malarvaty@gmail.com
Second Author – Dr. M.G. Sanal Kumar, Ph.D., Post Graduate and Research Department of Zoology, N.S.S. College, Pandalam, Kerala, India. mgsanalkumar@gmail.com

Correspondence Author – V. Jayalekshmy, lekshmi.malarvaty@gmail.com, +91 9961039878

