

A study on ichthyofauna in relation to physico-chemical parameters of Mannarappara tod, a tributary of Achenkovil river, southern Kerala

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ABSTRACT

The present study was conducted at Mannarappara tod, a tributary of the Achenkovil river in the Achenkovil reserve forest, part of the Western Ghats. The study period was from January to December 2019. Sampling was conducted monthly between 9am and 2pm. Fishes were collected using a cast net and scoop net. Water samples were collected in 1L sterilized bottles. The parameters Colour, Odour, Bottom Visibility(BV), Water column depth, Water temperature, p^H , Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Hardness (TH), Current velocity, Total Dissolved Solids (TDS) and Electrical Conductivity (EC) were selected for physicochemical analysis. Water column depth, Water temperature, p^H , Current velocity, TDS, EC were recorded using portable equipment; the remaining parameters were analysed using laboratory procedures. *Dawkinsia filamentosa*, *Haludaria fasciata*, *Barilius bakeri*, *B. gatensis*, *Danio malabaricus*, *Garra mullya*, *Hypselobarbus curmuca*, *Rasbora daniconius*, *Salmostoma boopis*, *Mesonoemacheilus triangularis*, *Pseudotroplus maculatus*, *Xenentodon cancila* and *Aplocheilichthys lineatus* were collected from Mannarappara tod. Mannarappara tod is a high altitude forested stream with less human intervention, or other factors could not be seen to affect this stream. The physicochemical parameters show that the stream is a healthy one. Therefore, fish species obtained from this stream can be considered indicators of a healthy stream.

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1. Introduction

Streams and rivers constitute major aquatic resources throughout the world. Each forested stream is the basic root of the aquatic ecosystem (Stringer and Vicki, 2001). The Western Ghats account for a large portion of India's biodiversity. The Western Ghats streams play a vital role in sustaining species (Ramachandra and Balasubramanian, 2009). They vary from one stream to another depending on the altitude, flow, nature of their bed substrate, canopy closure, cover types and biotic community (Arunachalam, 2000). Physical and chemical properties determine the quality of water and thus stream health. The survival of any aquatic ecosystem depends on the physicochemical properties of its water. Physico-chemical parameters directly influence various biological functions of fishes. Fishes are the first to be affected by even the slightest changes in the stream. So they are considered to be the best indicators of the aquatic ecosystem. Therefore, the entire system can be assessed by understanding the fish diversity of an aquatic body (www.nps.gov, 2021).

Mannarappara tod, a high altitude stream of the Achenkovil river, was selected for the present study. The current study was conducted to understand the physicochemical characteristics of stream water and its relation to the ichthyofaunal diversity.

2. Materials and Methods

Study area

Mannarappara tod is an open stream with a width of only 8 m and canopy closure of 13%. It was formed by the union of small streams that originated from Vellamthetti and Kumaramkodi in the Achenkovil reserve forest, part of the Western Ghats. The study site is located between 9°14'20.2" N and 76°9'48.8" E.

Data Collection

The study was conducted on the 200m stretch of the stream. Fish and water samples were collected monthly for a period of one year (January to December 2019). Daytime sampling was conducted uniformly from 8.00 am to 2.00 pm all over the study area.

Collection, Preservation and Identification of Ichthyofauna

Casting was mainly used to collect fishes. Scoop nets were also used to capture the fishes found adjacent to the rocky substratum.

The collected specimens were preserved in 10% formalin for identification and further studies. The specimens were identified with the help of standard identification keys of Jayaram (1999), Talwar and Jhingran (1991) and the web fish database-fishbase (16-08-2020).

Collection and Analysis of Water Sample

The water sample required for laboratory analysis was collected in one litre sterilized bottles.

The parameters such as colour, odour and bottom visibility were noted by direct observation. Water column depth, Water temperature, p^H , Current velocity, TDS, and EC were measured using a meter scale, digital thermometer, p^H meter, current meter, TDS meter and conductivity meter, respectively. Other parameters like DO, BOD, COD and TH were estimated in the laboratory following standard analytical methods (APHA, 2005).

3. Results and Discussion

A total of 13 fish species - *Dawkinsia filamentosa*, *Haludaria fasciata*, *Barilius bakeri*, *Barilius gatensis*, *Danio malabaricus*, *Garra mullya*, *Hypselobarbus*

curmuca, *Rasbora daniconius*, *Salmostoma boopis*, *Mesonoemacheilus triangularis*, *Pseudetroplus maculatus*, *Xenentodon cancila* and *Aplocheilus lineatus* belonging to twelve genera of five families and four orders were found in Mannarappara todū. The order Cypriniformes formed the largest fish group in the stream with ten species. Only one species was recorded in the order Cichliformes, Beloniformes and Cyprinodontiformes. Four species are endemic to the Western Ghats - *Barilius bakeri*, *B. gatensis*, *Hypselobarbus curmuca* and *Mesonoemacheilus triangularis*. Of these two species (*Barilius bakeri* and *Mesonoemacheilus triangularis*) are under low risk nearly threatened category, one belongs to the endangered (*Hypselobarbus curmuca*) and the last one under the low risk least concern category (*Barilius gatensis*). *Haludaria fasciata* and *Rasbora daniconius* are low risk nearly threatened fish species and the other seven species are low risks least concerned (Sanal Kumar *et al.*, 2013).

Colour and odour are considered as the primary parameters of water quality assessment, because these are detected through direct observation. Any difference in these parameters indicates that there is something wrong with the quality of the water body. No characteristic changes were observed in colour and odour during the study period. Due to the high altitude nature of the stream, the water was clear, and the bottom of the stream was highly visible.

Water column depth is an important factor in determining the distribution of fishes. The location of each species in the water column mainly depends on their food habits. Larger fish species *Dawkinsia filamentosa*, *Danio malabaricus*, *Hypselobarbus curmuca*, *Salmostoma boopis* and *Xenentodon cancila* prefer in large pool habitat. According to Harvey and Stewart (1991), there is a very strong positive relationship between the depth of the pool and the size of the fish.

Cold-blooded aquatic organisms are unable to regulate their body temperature internally. Water temperature influences all their metabolic activities. Each organism prefers particular temperature ranges. The rise or fall in this water temperature can adversely affect the survival rates (Jain *et al.*, 2013). In the present study, the water temperature was recorded 25.9°C in August. This month is characterised by

heavy rainfall and wind, so the atmosphere temperature was 28.8°C. The highest water temperature of 31.9°C was recorded in May, while the atmospheric temperature in this month was 33°C. Most of the fish species were collected during May.

In the present study, the lowest p^H of 6.1 was observed in January when there was no rainfall, and the maximum p^H of 6.9 was found in June, accompanying the rainfall. Slightly acidic tendencies were observed in Mannarappara todū during the study period except the months with high rainfall. As the p^H value was not less than six, it was observed that the p^H changes could not affect the fish species in Mannarappara todū. Aquatic organisms prefer p^H close to the neutral value (www.hawaii.edu, 2021).

Oxygen is an essential element for the survival of all living things. All aquatic creatures use oxygen present in the surface water. Gas diffusion is more prevalent in colder water; the amount of oxygen dissolved in water depends on the water temperature. DO decrease to 6mg/L during March. Pool structures with the low flow were observed in March as there was no precipitation at all. Almost all aquatic organisms are found in these pools. This may have caused the DO value to be reduced. The maximum amount of DO was recorded 9 mg/L in June with high precipitation. In the present study, COD and BOD showed the highest in May and March, with 9.6 mg/L and 4 mg/L, respectively.

Water with TH below 60 mg/L is considered soft water that can be used for drinking (WHO, 2011). In the present study, the maximum TH value was recorded at 12 mg/L in February and April. The lowest value of 6 mg/L was observed in November. TH influences life stages of the fish. According to Luo *et al.*, (2016) Ca²⁺:Mg²⁺ ratio less than 1:2 or more than 8:1 adversely affects the hatching, feeding, development, larval growth and survival of *Gobiocypris rarus*. During the study period, the Mannarappara stream's water hardness was very low, and the water was soft. Therefore, TH does not affect the existence of fish in this stream.

Total Dissolved Solids (TDS) include all inorganic, organic matter and other dissolved substances in water. The presence of Minerals in water is essential for aquatic

Table 1. Systematic list and IUCN status of fishes collected from Mannarappara todū

Order	Family	Species	IUCN status
Cypriniformes	Cyprinidae	<i>Dawkinsia filamentosa</i> (VALENCIENNES, 1844)	LRlc
		<i>Haludaria fasciata</i> (JERDON, 1849)	LRnt
		<i>Barilius bakeri</i> (Day, 1865)	LRnt EWG
		<i>Barilius gatensis</i> (Valenciennes, 1844)	LRlc EWG
		<i>Danio malabaricus</i> (Jerdon, 1849)	LRlc
		<i>Garra mullya</i> (Sykes, 1839)	LRlc
		<i>Hypselobarbus curmuca</i> (Hamilton, 1807)	EN EWG
		<i>Rasbora daniconius</i> (Hamilton, 1822)	LRnt
		<i>Salmostoma boopis</i> (Day, 1874)	LRlc
			Nemacheilidae
Cichliformes	Cichilidae	<i>Pseudetroplus maculatus</i> (Bloch, 1795)	LRlc
Beloniformes	Belonidae	<i>Xenentodon cancila</i> (Hamilton, 1822).	LRlc
Cyprinodonti-formes	Apocheilidae	<i>Aplocheilus lineatus</i> (Valenciennes, 1846).	LRlc

[EWG- Endemic to the Western Ghats, EN- Endangered, LRnt- Low risk nearly threatened, LRlc- Low risk least concern]

Table 2. Physico-chemical parameters of Mannarappara tod

PARAMETER	RANGE
Colour	Nil
Odour	Nil
Bottom visibility	Visible
Water column depth (cm)	21.3 - 73
Water temperature (°C)	25.9 - 31.9
p ^H	6.1 - 6.9
Dissolved Oxygen (mg/L)	6 - 9
BOD (mg/L)	Trace - 4
COD (mg/L)	Trace - 6.3
Total Hardness (mg/L)	6 - 12
Current velocity (m/s)	0 - 0.518
TDS (ppm)	14 - 27
Electrical Conductivity (S/m)	20.89 - 40.29

organisms to survive. If the minerals are more than the limit, it will adversely affect the aquatic biota. The present study observed the high TDS value at 27 ppm in March with low precipitation. TDS decreased to 14 ppm during August - October with high rainfall. Dickerson and Garry (2011) found that increased TDS levels negatively affected the growth and survival of Lahontan Cutthroat Trout. However, under conditions of constant temperature and different TDS, the larvae of the Silvery minnow, *Hybognathus amarus*, were found to hatch earlier at low TDS (Cowley *et al.*, 2005).

TDS is associated with EC. It is the ability of water to conduct electric current. It is also a pollution indicator because the value of EC increases with respect to dissolved salts and heavy metals, some of which cause harmful effects on aquatic organisms. As the water temperature

5. References

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and evaporation increase, so does the EC (www.ace-project.org, 2021). In the present study, we found that EC increases during the months when the water temperature is higher. The maximum value of EC recorded in March was 40.29 S/m and a minimum conductivity of 20.89 S/m was observed from August to October with high rainfall, low water temperature and evaporation.

The good flow of water indicates the health of a stream. As the flow increases, more oxygen dissolves into the water and the water temperature decreases. It creates a suitable environment for aquatic organisms. The present study showed a high velocity in September with 0.51 m/s; a Velocity of Zero m/s was observed in March as there were only pool habitats.

4. Conclusion

The quality of the entire system is checked by analysing the fish species in a stream. No characteristic changes were noted in the colour and odour in Mannarappara tod. It is a high altitude stream, so the bottom is visible with high dissolved oxygen and low water temperature. All the other parameters were optimal for the normal activities of fish. The present study showed that the forested stream of Achenkovil contains an optimum level of physicochemical parameters. The fish species found in this stream can be considered an indicator of a healthy stream.

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