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Faunal composition of macroinvertebrates associated with aquatic macrophytes in Chaliakkara River, Kerala, India

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ABSTRACT

Aquatic macrophytes provide habitat to several macroinvertebrates and also support sustaining water quality. Studies have detailed that aquatic macrophytes maintain diversity and abundances of macroinvertebrates. In this study, two species of aquatic macrophytes Lagenandra sp. and Carex sp. were collected for an evaluation of their association with macroinvertebrate fauna in the Chaliakkara River (in the Southern part of India). We identified 252 specimens belonging to 10 different families. Among the collected specimens, 125 organisms were associated with Lagenandra sp. and 127 were associated with Carex sp. The dominant families at upstream stations were Hydropsychidae and Philopotamidae; it dominated midstream with Perlidae and Hydropsychidae. The downstream region is dominated by Ampullariidae. The outcomes at the upstream, midstream and downstream sites of the Chaliakkara River displayed strong differences among the diversity of macroinvertebrates. The highest species richness and abundance of organisms were noted in S3 followed by S4, S1, S6, S5, and S2. The first two stations were in the forest area and these sites were undisturbed. Regrettably, the downstream is defenseless to anthropogenic activities such as bathing, waste disposal, bridge constructions, etc. Thus, the significance of the conservation and protection of the freshwater ecosystems composed of aquatic macrophytes and associated macroinvertebrates needed for the sustainability of freshwater life.

Keywords

Macrophyte, Macroinvertebrate, Association, Chaliakkara, Water quality

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Introduction

The area along the Chaliakkara River is occupied by a variety of magnificent green plants and native aquatic plants. These aquatic plants provide habitat for a variety of macroinvertebrates, including larvae of caddisfly, dragonfly, damselfly, snails, and aquatic beetles. (Vipin *et al*., 2012). The Chaliakkara River predominated with those plants their body except the root found above the water and lower portion grow underwater, and such plants are called emergent plants. Emergent plants play a dynamic role in the sustainability of the freshwater ecosystem and through photosynthesis, they serve as chief producers of oxygen. The presence of the dense root mass of aquatic macrophytes and their faunal abundance of macroinvertebrates turn into the feeding sites for different aquatic organisms. (Tessier *et al*., 2004). Because of its peculiar morphological structure, Emergent macrophytes present a great diversity of associated macroinvertebrates when compared to other types of aquatic plants. (Thomaz and Cunha, 2010). Macroinvertebrates have a significant role in the assessment of river water quality and are also broadly employed in Kerala. (Sreejai *et al.,* 2020, Beena *et al.,* 2019, Beena *et al*., 2020, Dani *et al*., 2019,) Along with phytoplankton, macroinvertebrates, and fish fauna, Macrophytes are also employed in the assessment of aquatic health. (Gebler *et al*. 2014). Macrophytes-macroinvertebrates relationship is extensively illustrated in various studies, and their ecological significance was being a common topic of research over a long period. (Nancy and Christopher 2011, Wiegleb *et al.,* 2015,). The variety of factors to influence the growth of macrophyte communities are nutrient concentrations, flow velocity, hydrological conditions, shading, carbonate hardness, landscape pattern, and hydro morphological modifications. (Fennessy *et al*, 1994, Dawson and Kern-Hansen 1979). The present study is directed towards the association of two selected macrophytes with various macroinvertebrates with limnological parameters on the Chaliakkara River.

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Materials and methods

Study sites

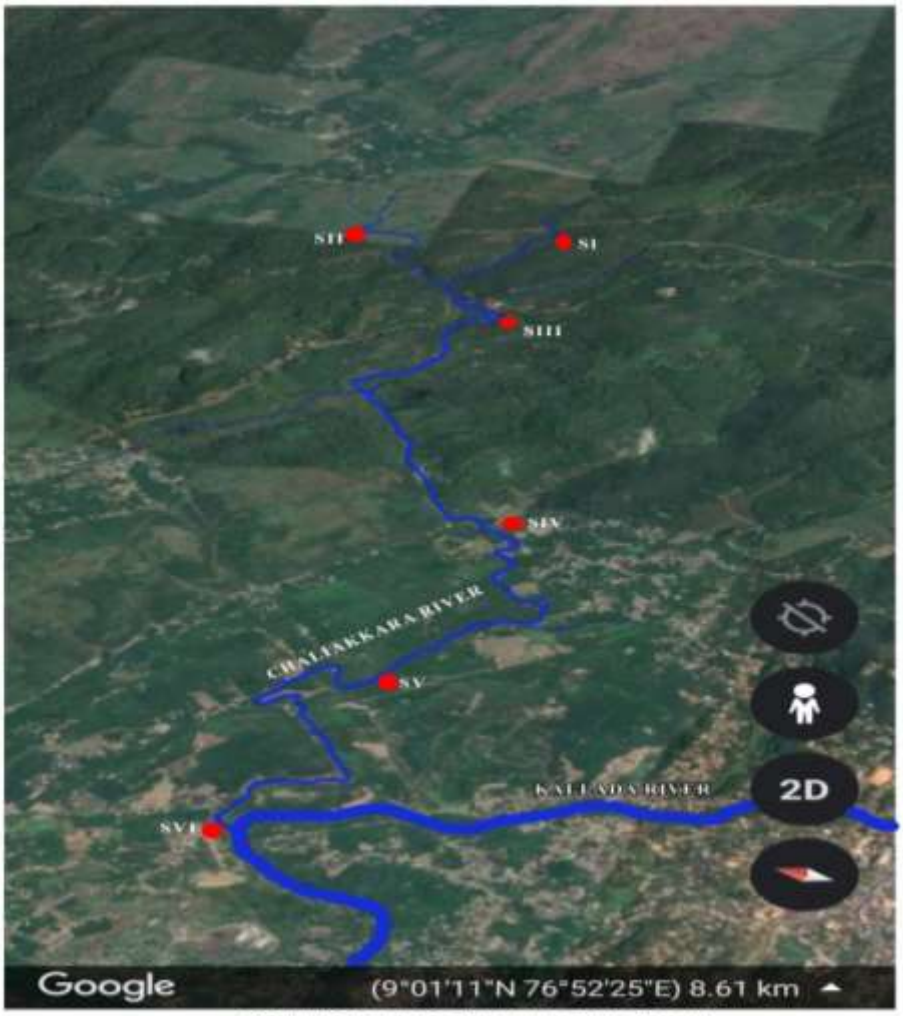

Fig 1: Location of study area and sampling sites (SI–SVI) (Direction of river flow is east to west)

The Chaliakkara River originates from the Mambazhathara slopes of the Western Ghat region. (Southern part of Kerala, India) (Fig.1). The river flows 23 km through the forest zone before ending at the Kallada River. The upstream sampling sites S1- Kuravanthavalam, S2- Mambazhathara, and midstream sites S3- Chaliakkara, S4 - Pathupara, and downstream S5-Vanmala, S6-Mukkadavu are the selected locales. The samples were collected from each site. Kuravanthavalam and Mambazhathara are the most undisturbed part

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of the River. Here the human population is sparse. The trees of the Mambazhathara forest line up on both sides of these sites. The midstream regions are occupied with rubber plantations. Vanmala area is blessed with plenty of aquatic macrophytes. The last station Mukkadavu is the region where the river ends into the Kallada River. Human activities such as bathing, waste dumping the major threat to this site. The six sampling sites (Fig 1 map) were consistently sampled in the pre-monsoon season period from 2019 February to May 2019. The sampling is carried out per month from February to May between 8: 00 a.m. and 10: 00 a.m. at each site throughout the study period.

Analysis of response variables

The collection of macrophytes is done by using a long wooden rod with an iron hook placed into the region of macrophytes strands and the macrophytes get twisted by rotating the club. Two or three rotations were enough for the required macrophytes samples. (Beckett *et al*., 1991). After collection, macrophytes were washed to get rid of associated macroinvertebrates. Macroinvertebrates were preserved in 10% formalin. Collected macrophytes were identified with the keys of Cook 1996 and Adoni 1985 and macroinvertebrates were identified with the help of Ward & Whipple 1959, Subramanian and Shivaramakrishnan 2005, Day *et al*., 1989, Catherine and Yong 2004). Different taxonomical indices such as Margalef's richness index, (Margalef, 1968), Shannon-Weiner index (Shannon and Weiner, 1964), Simpson's Dominance Index (Simpson, 1949), and Menhinick Index (Menhinick, 1964) were used for data analysis. (Fig.2).

Results and discussion

Water quality parameters

The physicochemical of water is an important factor that influences the association of macroinvertebrate fauna with aquatic macrophytes. The pH of water at all sites shows alkaline. The high DO contents in SI were due to the powerful water current. (Dani *et al*., 2020). The alkalinity and hardness showed a maximum at SIII. Subsequently, the lowest concentrations of these parameters were observed in SI. The concentration of Nitrate, Phosphate, and Silicate influences the macroinvertebrate density in the two selected macrophytes and represents one of the fundamental factors (Table. 2).

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Parameters	Mean ± S.D	Range
Water Temperature (^{0}C)	24.33 ± 0.57	24-25
pH	6.73± 0.35	6.32-6.97
Dissolved oxygen (mg/l)	6.9 ± 0.6245	6.2-7.4
CO_2 (mg/l)	5.333 ± 1.154	4-6
Nitrate (mg/l)	0.174 ± 0.101	0.059-0.246
Phosphate (mg/l)	0.224 ± 0.002	0.221-0.226
Silicate (mg/l)	5.624 ± 0.908	5.033-6.67
Total Alkalinity (mg/l)	18.666 ± 3.055	16-22
Total Hardness (mg/l)	14.666 ± 4.163	10-18
K (mg/l)	1.31 ± 0.295	0.98- 1.55
Na (mg/l)	3.623 ± 0.047	3.57-3.66
Ca (mg/l)	1.962 ± 0.485	1.682-2.523

Table 1. Mean value of physico-chemical characteristics of water in Chaliakkara River

Macroinvertebrate - macrophyte association

This is one of the pioneer studies that analyze the association between macroinvertebrates and aquatic macrophytes in the Chaliakkara River. 252 specimens were recorded. Among the macroinvertebrates, 125 specimens were associated with Lagenandra sp. and 127 were associated with Carex sp. Altogether, 10 different families were identified. Among the families, Baetidae, Elmidae, Hydropsychidae, Gomphidae, Perlidae and Philopotamidae were present in upstream stations. Gomphidae were absent in midstream and downstream stations. Naididae absent in all stations except midstream station S3. Hydropsychidae were the dominant taxa in SI, S2, and S4. Perlidae in S3 and Ampullariidae in S5 and S6. S3 was the richest with maximum density and diversity followed by S4 S1, S6, S5, and S2. (Table 2).

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	Lagenandra sp.						Carex sp.					
Clade												
	S1	**S2**	**S3**	**S4**	**S5**	**S6**	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Ampullariidae	-	-	1	1	5	6	-	-	1	-	6	7
Baetidae	4	2	3	2	4	5	3	2	2	1	6	5
Dytiscidae	-	-	3	2	2	3	-	-	3	4	3	2
Elmidae	2	4	2	1	-	-	2	1	1	2	-	-
Hydropsychidae	4	3	9	5	4	6	5	3	4	6	3	2
Gomphidae	2	1	-	-	-	-	4	2	-	-	-	-
Perlidae	2	1	7	4	1	1	3	1	8	7	1	1
Philopotamidae	4	2	7	4	-	-	5	3	6	5	-	-
Psephenidae	-	-	4	1	-	-	-	-	4	3	-	-
Naididae	-	-	1	-	-	-	-	-	-	-	-	-
Total abundance	**18**	**13**	**37**	**20**	**16**	**21**	**22**	**12**	**29**	**28**	**19**	**17**
Relative abundance %	**7.1**	**5.1**	**15**	**7.9**	**6.3**	**8.3**	**8.7**	**4.8**	**11.5**	**11.1**	**7.5**	**6.7**
Richness	**6**	**6**	**9**	**8**	**5**	**5**	**6**	**6**	**8**	**7**	**5**	**5**

Table 2 . Abundance of individuals per species in three sampling stations of Chaliakkara River

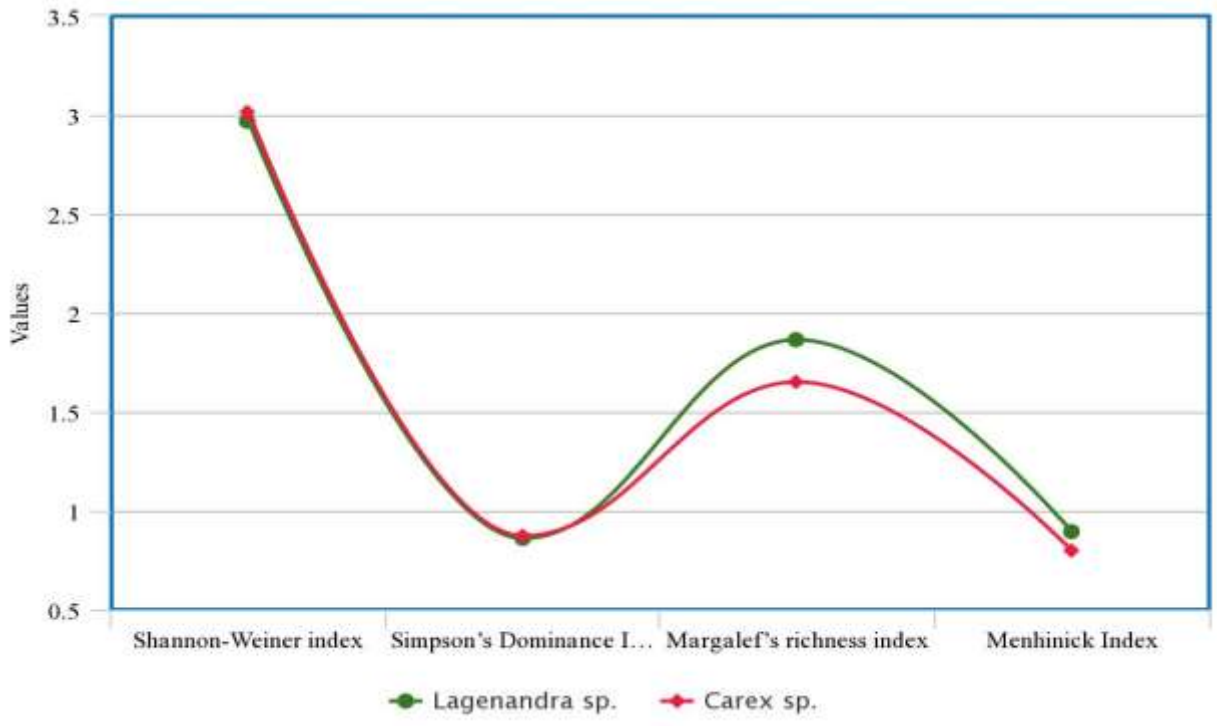

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Fig: 2 Taxonomic indices of macroinvertebrate communities associated with macrophytes in Chaliakkara River.

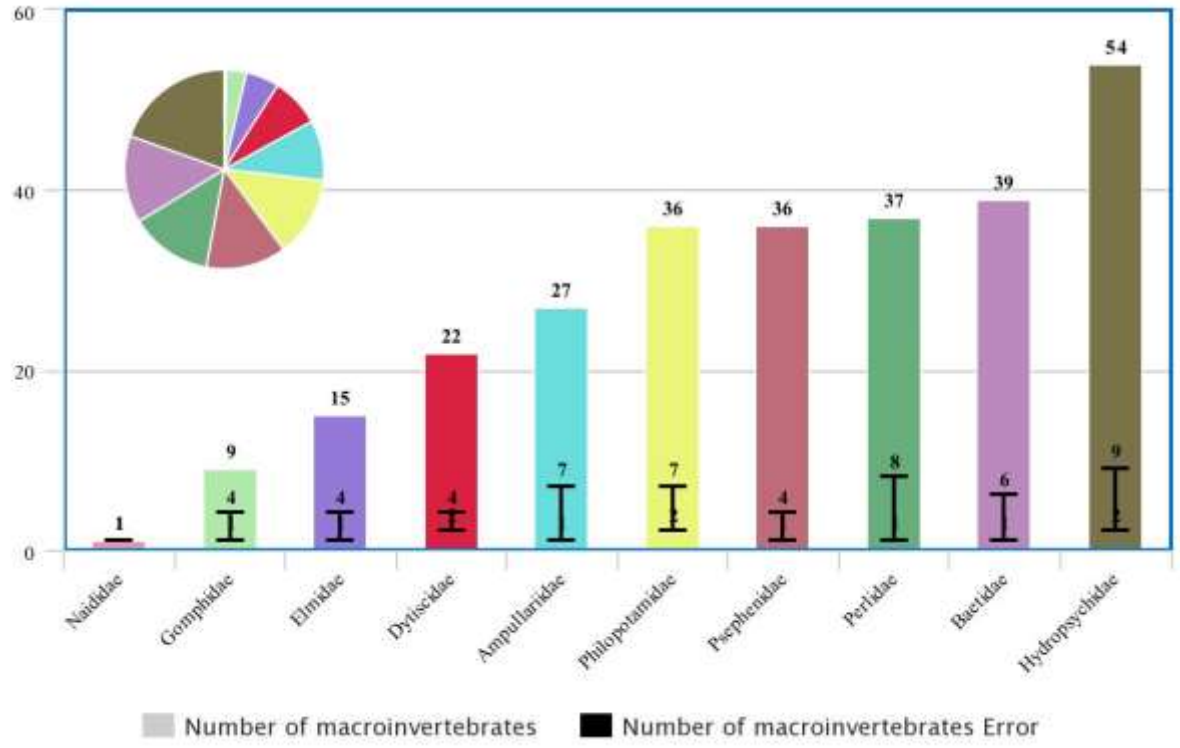

Fig : 3. Faunal composition of macroinvertebrate families in Chaliakkara River

Conclusion

The Chaliakkara River is a treasurable pool of macroinvertebrate and macrophytes communities. The water quality of the study area was found to be almost good and advantageous for the growth of aquatic plants. The presence of macrophytes such as Lagenandra sp. and Carex sp. demonstrates the essential maintenance capacity of macroinvertebrate fauna, supporting not only the biological diversity but also the sustainability of freshwater species

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