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Short Communication

First report on the diversity of epiphytic algae in the riparian lentic habitats of the western ghats river Achankovil, Kerala

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The world is experiencing drastic environmental effects from climate change, prompting researchers worldwide to investigate the consequences. Natural disasters not only endanger human lives but also cause irreversible changes and biodiversity loss, negatively affecting the quality of ecosystem services (Das, 2019). Rich biodiversity indicates the safety and pristine nature of the Earth, but climate change, ecosystem degradation due to overuse and pollution, and the emergence of invasive species threaten biodiversity (Smith *et al.*, 2003).

The Achankovil River, one of the major west-flowing rivers in peninsular India, flows through the Kerala districts of Kollam, Pathanamthitta, and Alappuzha. This 128-kilometer river originates from the streams of Pasukidamedu in the southwestern Ghats and flows through several important towns in the Pathanamthitta district, including Pandalam finally it joins with river Pampa at Veeyapuram in the Alappuzha district. Throughout its course, the river has developed numerous small and large water microhabitats, some of which are seasonal flood plains while others are ephemeral areas. The river and surrounding areas were severely affected by ecosystem changes, habitat loss, and species loss during every flood. The riverine bodies in the district are rich in fish and other biological species. Swapna (2009) recorded 52 fish species in the river. A new checklist with a record of 35 species of ichthyofauna in the Achankovil basin was prepared by Vishnu *et al.* (2023). Phytoplankton in the water bodies are significant contributors of oxygen and play an essential role in maintaining the balance between living species. Previous algal enumerations in the river have focused only on its lotic systems (Krishnan *et al.*, 2020), with little attention given to the riparian phytoplankton and epiphytic flora. Therefore, we decided to conduct a biodiversity study of the attached microalgae in the flood-affected Achankovil River in Pandalam Municipality. Understanding the biodiversity of areas affected by climate change is crucial for identifying existing species, the presence of invasive species, vulnerable species, and harmful species in the changed ecosystem. Regular auditing is required to create databases and develop restoration plans. Pandalam Municipality covers a total area of 28.72 km^2 and consists of 33 wards, situated between 9.2250° N latitude and 76.670° E longitude. We selected six flood vulnerable wards for sampling, establishing a total of six sampling stations (one in each ward). The stations were designated as PN (Pandalam Station Number), specifically PN1, PN2, PN3, PN4, PN5, and PN6 (Figure 1).

Between December 2021 and December 2022, regular monthly field visits and sample collections were conducted between 9 a.m. and 10 a.m. Samples were collected from the riverine water bodies of the River at each of the fixed stations. Epiphytic algae were collected from the leaves of colonization-supporting submerged plants such as *Hydrilla, Nymphaea*, and various grasses. The thin film of algae that developed on the surface of these plants was stripped and preserved in 100 ml of double-distilled water in pre-sterilized plastic bottles. All collected water samples were preserved in Lugol's iodine following standard procedures (Santhanam *et al.*, 1989). Periphytons (epiphytic algae) were identified using a compound microscope (MX21i Clinical) at 100X magnification. Identification was done using standard keys (Bellinger and Sigee, 2015; Desikachary (1959), Spaulding *et al.*, 2021). The phytoplankton were separated into classes and organized into tables. The algae were classified according to the Round (1973) system. The samples were deposited in the Botany Laboratory at NSS College, Pandalam, Kerala.

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Table 1: Identified Epiphytic algae of Achankovil River at Pandalam, Kerala

Sl. No.	Name of Class	Scientific Name
1	CYANOPHYCEAE	*Anabaena cylindrica* Lemmermann
2		*Arthrospira platensis* (C.B.Rao) Desikachary
3		*Lyngbya* sp.1
4		*Oscillatoria formosa* Bory ex Gomont
5		*Rivularia* sp.1
6	EUGLENOPHYCEAE	*Euglena caudata* E. Hubner
7		*Euglena acus*
8		*Phacus* sp.1
9		*Phacus acuminatus*
10	CHLOROPHYCEAE	*Chlorococcum humicola* (Nageli) Rabenhorst
11		*Coelastrum microporum* Nageli
12		*Crucigeniella crucifera* (Wolle) Komárek
13		*Dictyochloropsis* sp.1
14		*Oedogonium* sp.1
15		*Oocystis lacustris* Chodat
16		*Radiococcus nimbatus* (De Wildeman) Schmidle
17		*Scenedesmus denticulatus* Lagerheim
18		*Scenedesmus ellipticus* Corda
19		*Scenedesmus quadricauda* (Turpin) Brébisson
20		*Spirogyra* sp. 1
21	CHAROPHYCEAE	*Closterium navicula* (Brebisson) Lütkemüller
22		*Closterium parvulum* Nageli
23		*Cosmarium didymoprotupsum* West & G.S.West
24		*Cosmarium hammeri* Reinsch
25		*Cosmarium impressulum* Elfving
26		*Cosmarium obsoletum* (Hantzsch) Reinsch
27		*Cosmarium quadrum* P.Lundell
28		*Cosmarium subprotumidum* Nordstedt
29		*Cosmarium subtumidum* Nordstedt
30		*Euastrum binale* F. Crassum Joshua
31		*Euastrum denticulatum* F.Gay
32		*Euastrum pulchellum* Brébisson
33		*Micrasterias laticeps* Nordstedt
34		*Pleurotaenium archeri* Delponte
35		*Pleurotaenium ehrenbergii* (Ralfs) De Bary
36		*Pleurotaenium trabecula* Nageli
37	BACILLARIOPHYCEAE	*Achnanthidium minutissimum* (Kutzing) Czarnecki
38		*Amphora inariensis* Krammer
39		*Amphora* sp.1
40		*Aulacoseira granulata* (Ehrenberg) Simonsen
41		*Cyclotella meneghiniana* Kutzing
42		*Cymbella* sp.1
43		*Diadesmis confervacea* Kutzing
44		*Frustulia rhomboides* (Ehrenberg) De Toni
45		*Gomphonema affine* Kutzing
46		*Gomphonema lagenula* Kutzing
47		*Gomphonema olivaceum* (Hornemann) Ehrenberg
48		*Gomphonema venusta* Passy, Kociolek & Lowe
49		*Navicula lanceolata* (C.Agardh) Kutzing, nom. illeg.
50		*Navicula* sp.1
51		*Nitzschia agnita Hustedt*
52		*Nitzschia clausii* Hantzsch
53		*Nitzschia desertorum* Hustedt
54		*Pinnularia divergens* W.Smith
55		*Pinnularia gibba* (Ehrenberg) Ehrenberg
56		*Pinnularia rectangularis* Y.Liu, Kociolek & Q.-X.Wang
57		*Pinnularia* sp.1
58		*Pinnularia viridis* (Nitzsch) Ehrenberg
59		*Rhoicosphenia abbreviata* (C.Agardh) Lange-Bertalot
60		*Sellaphora pupula* (Kutzing) Mereschkovsky
61		*Synedra* sp.1

**sp.-species*

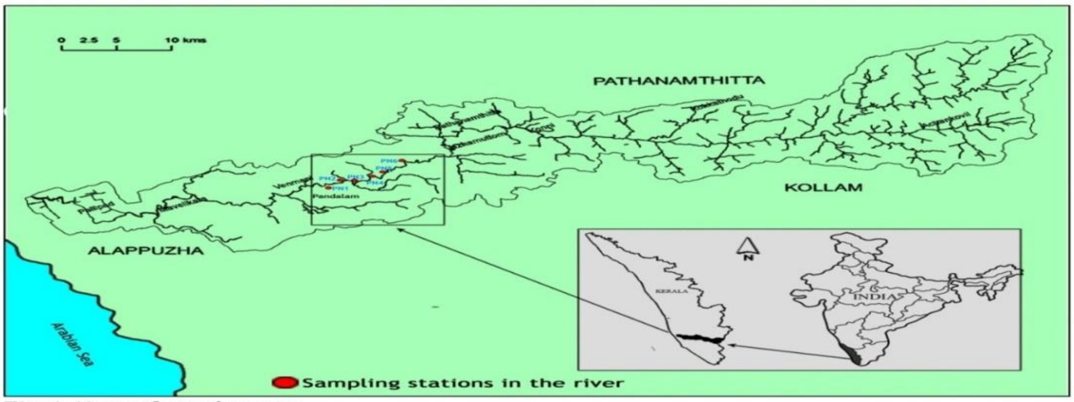

Fig 1.Map of study area

This study documented 61 algal taxa from ephemeral to perennial lentic water habitats of the river, with 50 identified to the species level. The identified taxa belong to 61 genera under five classes: Bacillariophyceae (25), Charophyceae (16), Chlorophyceae (11), Cyanophyceae (5), and Euglenophyceae (4). Previous investigations by Krishnan *et al.* (2020) indicated the dominance of Chlorophyceae, while Charophyta and Bacillariophyta were dominant in the microalgae of rivers in Pathanamthitta (Harikrishnan, 2010). Our results corroborated these findings, with Bacillariophyceae being the dominant class (25 genera). The genus *Cosmarium* (Desmidaceae) was the most dominant, with seven species, followed by the diatoms *Pinnularia* and Gomphonema, each with four species. *Scenedesmus quadricauda* was present at all stations.

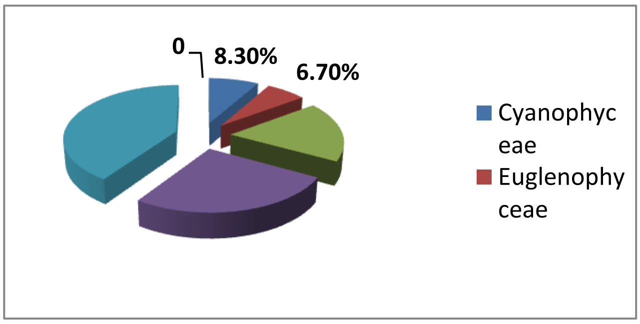

Figure 2: Percentagewise distribution of different Classes of Epiphytic algae

The percentage distribution of different classes was calculated: 40.9% diatoms, 26.7% Charophyceae, 18.3% Chlorophyceae, 8.3% Cyanophyceae, and 6.7% Euglenophyceae (Figure 2). The highest number of algal genera was observed at PN2 (17), and the lowest at PN5 (8 taxa). Other stations had between 10 and 13 genera. The high density of taxa at PN2 could be due to the presence of large riparian lentic water habitats, which allowed for multiple representative samples. In contrast, PN5 had fewer colonization-supporting submerged plants due to the presence of small rocks and mud-filled shores and was severely affected by landslides, leading to fewer periphytic algae samples. The increased number of Euglenophytes at PN6 could be attributed to human contaminants increasing nitrate availability. This station is near the pilgrimage area of Pandalam Valiyakoikal Palace, heavily used by Sabarimala pilgrims for sanitary purposes. According to Kumar *et al.* (2018), a higher number of Euglenophytes indicates decaying organic contaminants, a presence also reported by Krishnan *et al.* (2020). The presence of pollution-tolerant *Scenedesmus* at this station indicates water degradation due to pollution (Paul and Sreekumar, 2008). *Nitzschia* and *Cymbella*, also found at PN6, are known pollution indicator species (Palmer, 1969). Among the five classes of algae identified, most were dwellers in oligotrophic habitats, with Desmids and diatoms being more numerous. Their predominance indicates good water quality (Krishnan (2012). According to Coesel (1982), increased eutrophication leads to a decrease in desmids and an increase in planktonic forms. Some stations in the present study showed anthropogenic influences and a trend towards pollution. Pollution indicator species like *Nitzschia palea* were observed at PN1 and PN6, possibly due to human feces and nitrate enrichment.

This investigation reveals that the riparian lentic microhabitats of the Achankovil River in Pandalam Municipality are rich in periphyton biodiversity. Flood events have disturbed the

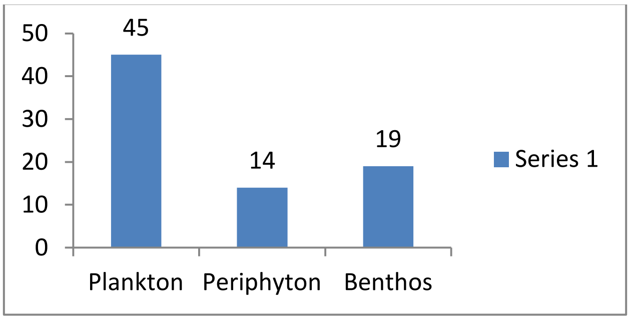

Figure 3: Total number of different categories of algae

community structure, leading to the mixing of waters and the presence of pollution indicators and flagellated forms at some stations. The river is heavily used during the pilgrimage season, and care should be taken to prevent habitat and species loss during flood events, as Pandalam is flood-prone. Detailed investigations are required to understand the lost species, invasive species, and endemic species of the area. Since no previous records on the periphytic algal diversity in riverine perennials and ephemerals were available from the region, this study may serve as baseline data for future research on the algal biodiversity of the precious ecosystems in and around the Pandalam municipal area.

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