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Seasonal abundance of zooplankton in the Ashtamudi lake – southwest coast of Kerala, India

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ABSTRACT

Seasonal abundance of zooplankton in the Ashtamudi lake was studied. Monthly zooplankton samples were collected from ten different stations of the Ashtamudi lake for a period of one year from February 2018 to January 2019. Sixteen zooplankton groups viz. medusae, chaetognaths, polychaetae, copepods, decapod larvae, cladocerans, stomatopod larvae, ostracods, gastropods, mollusc larvae, mysids, amphipods, isopods, lucifer, fish egg and fish larvae were observed. Among these, copepods were the most prominent group and contribute 41.59% of the total zooplankton group. Total abundance of different zooplankton groups was about 21171796.44 No/100m^3 were observed from the study area. Zooplankton abundance was maximum at S7 near the barmouth and minimum zooplankton abundance was observed at S1 near the upstream. The seasonal abundance of different zooplankton groups was maximum during pre-monsoon season (40.34%) which is followed by post-monsoon season (31.91%) and monsoon season (27.75%). Various diversity indices were also presented in this study.

Key words *: Zooplankton, Biodiversity, Estuary*

Introduction

Wetlands are one of the worthwhile resources of worldwide ecosystem and they can support a tremendous level of biological diversity and serves enormous services to the environment. They can uphold water and nutrient cycle control the ecosystem balance (Lie and Cameron, 2001). According to Ketchum (1951), estuaries are transitional zone between land and sea. In the estuarine ecosystem zooplankton were the major community by their abundance and diversity. Ashtamudi Lake is the tropical backwater habitat and is considered as one of the Ramsar sites in India, situated on the southwest coast of Kerala. Lake gets its name regarding to the plannimetric shape with eight briads radiating from central part of the estuary. The planktons are organisms that drift in water column and whose capacity for locomotion are insufficient to withstand the water current.

Zooplankton community is a heterogeneous assemblage of animals inhabiting the aquatic ecosystem covering many taxonomic groups. Ecologically zooplankton are most important biological components influencing all functional aspects of an aquatic ecosystem such as food chain, food web, energy flow and cycling of matter (Park and Shin, 2007). Zooplankton abundance and diversity is considered as an index of fertility as fishery resources of any aquatic system mainly depends on plankton population of the system. Zooplankton are perceived as sign of pollution in aquatic environment (Yakuba *et al.,* 2000). Zooplankton abundance and distribution depends on the movement of water, season, depth, ecological characteristics and other environmental conditions. Various studies are carried out about zooplankton in estuaries in India (Haridas *et al.* 1973; Pillai *et al.* 1975; Madhupratap, 1978; Nandan

and Azis, 1994; Patil *et al.* 2002; Qasim, 2005).

Significance of the study was plankton's biodiversity helps to get ideas about productivity of the lake ecosystem. Lake biodiversity is being lost at an unpredicted rate because of various human activities. Zooplanktons play an important role to study the faunal biodiversity of aquatic ecosystem. They feed on phytoplankton and facilitate the conversion of plant material into animal tissue and in turn constitute the basic food. Proper methods must be taken to compensate this loss.

The main objectives of the study were

- To assess spatial and temporal variations of zooplankton in the Ashtamudi Lake.
- To assess the biodiversity and ecology of zooplankton.
- To study various diversity indices related to the zooplankton.

Materials and Methods

Study area

Ashtamudi Lake is the second largest estuary with a palm shaped water spread. The lake is located between 8° 31'-9°02' N lat. and 76° 31' and 76° 41' E long. Ashtamudi wetland is included in the list of wetlands of international importance, as defined by the Ramsar Convention (Ramsar site no. 1204). The estuary covers a total area of 5500 ha. and has a length of about ~16 km and a width of ~15 km. Kallada river is the only freshwater source enters to Ashtamudi estuary. The estuary has a permanent connection with Arabian Sea at Neendakara harbour. Study area was divided into different zones.

Zone 1 situated near the upstream or head of the estuary, includes Koivila (S1) and Peringalam (S2)- Kallada river joins to the Ashtamudi estuary through this region. There are many small islands and shows more similarity to freshwater. Koivila boat jetty is located. Zone II includes Padappakkara (S3) and Kanjiracode (S4)- stations nearest to Kundara, so wastes from clay factory deposits in this region and deepest region of the estuary. Zone III is almost central portion of the lake covers Perumon (S5) and Ashtamudi (S6). The eight muddies of the lake joins at Ashtamudi. Here Chinese fishing nets mostly seen fishing area. Zone IV is near the barmouth have Sambranikodi (S7) and Kavanadu (S8). Nearest stations to the sea. Many mechanized and fishing boats traverse are harbored in this region. Oil spillage is the main pollutant here. Zone V is the southernmost region of the lake with coir retting Mangadu (S9) and Kandachira (S10) (Figure 1).

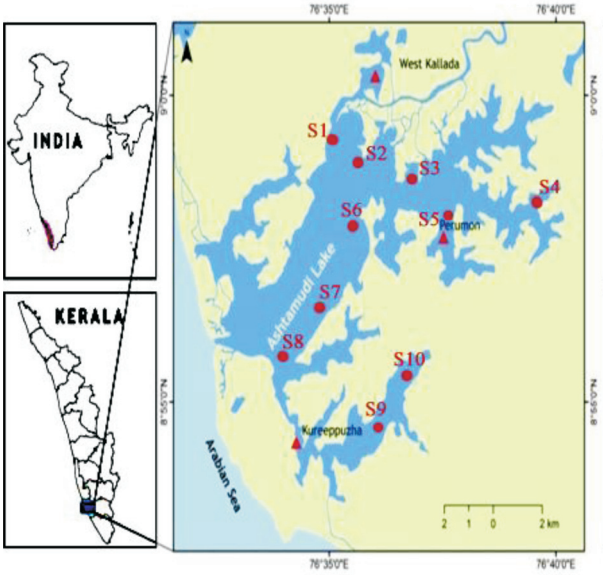

Fig. 1. Study area.

Sampling procedure and data analysis

Samples were collected monthly from ten different stations of the lake for three seasons, pre-monsoon (February to May), monsoon (June to September) and post-monsoon (October to January) (Mathew *et al.*, 2003) for a period of one year from February 2018 to January 2019.

Zooplankton samples were collected using working party net (WP net), with a mesh size of 200 ˜m and mouth area is 0.6 m^2. To measuring volume of water filtered through the net, a flow meter is mounted. The net was towed just below the surface of water for 10 minutes using a boat of approximately 2 knot speed. The collected samples were preserved in 4% formaldehyde (Harris *et al.*, 2000). In the laboratory, different groups of zooplankton are sorted identified from the collected samples with by standard identification keys of UNESCO (1968), Pillai (1973) and Biju (2018).

Results and Discission

Zooplankton Biomass

Zooplankton biomass was observed in a range of

12.62 ml/100m^3 to 137.50 ml/100m^3. Maximum zooplankton biomass was observed at station 7 (69.81 ± 49.17 ml/100m^3) and minimum zooplankton biomass was recorded at station 1 (20.93 ml/100m^3). In the present study maximum zooplankton biomass was recorded during pre-monsoon season followed by post-monsoon season and least zooplankton biomass was observed during monsoon season.

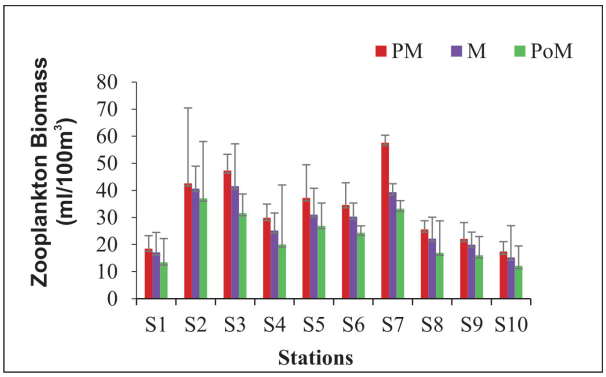

Fig. 2. Represents seasonal variations of zooplankton biomass at different stations.

Zooplankton Abundance

Zooplankton abundance fluctuated at different stations and seasons during the study period. A total zooplankton abundance of 21171796.44 No/100m^3 was observed. Abundance of zooplankton indicates that a maximum abundance was observed at station 7 (19.32 %) and a minimum abundance was recorded at station 1 (3.81%) (Figure 3). Monthly studies reported zooplankton abundance was maximum during the month of April (12.13%) followed by October (10.65%), February (10.25%), May (9;.69%), March (8.51%), November (7.97%) and minimum zooplanton abundance was observed during June (6.11%). The percentage of zooplankton abundance was reported minimum in the month of July by Madhupratap and Haridas (1975) from Cochin backwaters.

Station 1 nearest to the freshwater discharge and many pollutants such as detergents and other sewage disposal occurs in this region. At this station zooplankton cannot withstand due to the river water runoff and more rainwater flow. The abundance of zooplankton was observed highest at stations near bar mouth and lowest at stations to upstream (Molly Varghese *et al.*, 2022). Station 7 is nearest to barmouth and station 1 is nearest to upstream

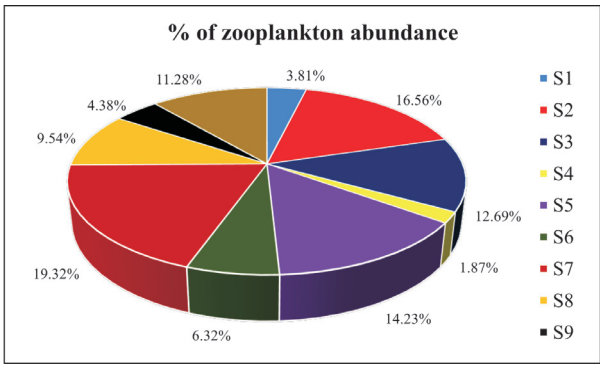

Fig. 3. % Of Zooplankton abundance at different stations (No/ 100m^3) in Ashtamudi Lake.

where freshwater discharge occurs. The zooplankton abundance was increasing due to the presence of large number of zooplankton groups as, medusae, chaetognaths, copepods, lucifer. The more saline nature of water provides a favourable and most stable environmental conditions for many zooplankton groups. The seasonal distribution of zooplankton indicates that highest abundance was reported in pre-monsoon season (40.34%) which is followed by post-monsoon season (31.91%) and in monsoon season (27.75%). Similar observations were reported by Molly Varghese (2022), the highest peak of zooplankton was observed during pre-monsoon season (52%) followed by post-monsoon season (36%) and monsoon season (12%). During pre-monsoon season more stable environment and uniform hydrographic features are shown by estuarine water and provides suitable environment for zooplankton (Kothandapani *et al.*, 2016) also reported by Madhu *et al.*, 2007 in Cochin backwaters. The depletion in zooplankton community was observed during monsoon season due to freshwater influx from the river in upstream (Perumal, 2009).

Zooplankton diversity

The mesozooplankton community was composed of 16 taxonomic groups as medusae, chaetognaths, polychaetae, copepods, decapod larvae, cladocerans, stomatopod larvae, ostracods, gastropods, mollusc larvae, mysids, amphipods, isopods, lucifer, fish eggs and fish larvae. Copepods were the most abundant zooplankton group in the present study (41.59%), which is followed by chaetognaths (15.64%), other zooplankton groups were observed below 10 %. The maximum abundance of copepods was reported during April (11.94%) followed by February (10.74%). The similar observations such as

copepods were maximum during April (22%) followed by February (14%) were reported by Molly Varghese *et al.,* 2022. The copepod dominance in the zooplankton group have been reported in various zooplankton studies by Jeyaraj *et al.,* 2014; Nair *et al.,* 1984 in Kadinamkulam estuary, Nagaraja and Guptha, 1985; Nair and Azis 1987 in the Ashtamudi estuary, Kuruppasamy and Perumal 2000 in the Pichavaram mangrove. Copepods were the most dominant among the zooplankton groups in Indian estuaries (Qasim, 2005) because they have breeding throughout the year. They can accommodate most of the seasonal variations. The zooplankton diversity indices in different stations were calculated. High zooplankton abundance during pre-monsoon season indicates the key role of salinity in the estuary. The minimum values in June due to temperature fall, heavy rainfall and river runoff washes out zooplankton groups inhabiting in surface of aquatic ecosystem.

Table 3. Diversity indices of zooplankton at ten stations of the Ashtamudi Lake (2018-2019).

Stations	d	J′	H′
S1	1.23	0.71	1.98
S2	2.76	0.96	2.13
S3	2.67	0.84	2.54
S4	2.54	0.73	2.43
S5	3.11	0.98	2.79
S6	2.12	0.76	2.98
S7	3.23	0.97	3.78
S8	1.35	0.92	3.03
S9	2.64	0.81	2.96
S10	3.24	0.87	2.74

d=Margalef's index, J'=Pielou's index, H'=Shannon wiener's index

The minimum Margalef index of zooplankton groups were recorded at station 1 (1.23) and maximum was observed at station 10 (3.23). The Pielou's index (J') was observed minimum at station 1.(0.71) and maximum at station 5 (0.98). The Shannon-wiener diversity index was minimum at station 1(1.98) and maximum at station 7(3.78).

Conclusion

Zooplankton was the major constituent in estuarine ecosystem as essential for maintaining healthy ecosystem. In the present study zooplankton abundance was highest during pre-monsoon season and lowest during monsoon season. The salinity was a vital factor for zooplankton distribution and abundance (Goswami and Padmavati, 1996), provide great neritic components from adjacent sea. The zooplankton abundance was low during monsoon season by food scarcity, lowering of salinity and temperature (Perumal *et al.,* 2009).

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