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Diversity of Zooplankton in Adimalathura Estuary, Southwest Coast of India

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ABSTRACT

Zooplankton is considered as the most important grazers of the phytoplankton. They are generally able to maintain themselves in a preferred depth, or in some cases to perform vertical migration from a near surface position at night and to deeper water in the day time Zooplankton plays an important role to study the faunal bio-diversity of aquatic ecosystems. It is occurrence and distribution influences the fishery potentials. The fishes mostly breed in areas where the planktonic organisms are plenty so that their young ones could get sufficient food for survival and growth. The zooplankton composition during the study period includes the members of Foraminifera, Rotatoria, Calanoida, Cyclopoida, Harpacticoidea, Doliolida, Appendicularia, Decapoda, Sagittoida, Amphipoda, Coelentrata, Pteropoda, Cladocera and larval forms. Totally 100 zooplankton were recorded. Species richness, evenness were calculated. Zooplankton population density varied from 19,986 to 21,8100 organisms/l.

Keywords : Estuary, Zooplankton, Adimalathura back water, diversity, species richness.

I. INTRODUCTION

A chain of brackish water systems exists in Kerala. These water bodies are the breeding and nursery grounds for commercially important fin-fishes and shell-fishes. Adimalathura Estuary (KarichaKayal), a small brackish water biotope (8^0 0' - 8^0 24' N latitude and 77^0 01' – 77^0 03'E longitude) on the southern part of Kerala, is important from the point of view of fishery and seed resources and constitutes the life line of the local economy. The western bank of the estuary where the Adimalathura fishermen reside is considered as the most densely populated area in the state. Zooplanktons are considered as the most important grazers of the phytoplankton. They are generally able to maintain themselves in a preferred depth, or in some cases to perform vertical migration from a near surface position at night and to deeper water in the day time .They are the small heterotrophic animals inhabiting the ocean of all depths and occupy almost every type of ecological environment. The rate of zooplankton production can be used to estimate the exploitable fish stock of an area (Tiwari and Nair, 1991).

Tropical aquatic ecosystems are the most productive areas with zooplankton production as high zooplankton biomass on productivity may be related to the input of energy and organic matter from coastal waters. In addition, zooplankton is also an important intermediated component in aquatic food webs and acts as a tropic link between small parotids (eg; detritus and micro organisms) and plankton. These ecosystem have an outstanding direct socio economic importance for many tropical coastal regions.

II. METHODS AND MATERIALS

In the present study, the zooplankton species composition and community structure were carried out to understand the present status in the study areas, Zooplankton samples were collected at monthly intervals from the surface waters by a horizontal towing plankton net (0.35m mouth diameter), made up of bolting silk (cloth no: 10; mesh size 158µm)for twenty minutes.

The samples were preserved in 5% neutralized formalin and used for the quantitative analysis. A known quantity of water (500 litters) was filtered through a bag net and the numerical plankton analysis was carried out using a binocular microscope. The zooplankton were identified following works of Davis (1957), Kasthurirangan

(1963), Newell (1963), Deboyed Smith (1977), Winpenny (1966), Todd and Lawrence (1991) and Perumal et al. (1998).

The zooplankton were collected 16 groups namely protozoa, foraminifera, ciliate, metazoa, hydrozoa, Cheatognatha, pteropoda, rotifer, cladocera, copepoda, amphipoda, decapoda, mysidaceae, appendicuaria, Larval forms and icthyoplankton. Zooplankton diversity, richness, evenness, and the dominance of species were calculated, using standard formula of Simpson index, Pielou's (1996) respectively.

III. RESULTS AND DISCUSSION

Monthly variations in zooplankton species composition, percentage composition, population density, species diversity, richness and evenness were recorded for a period of two year (January 2013 to December 2014) at Adimalathura Estuary.

A. Species Composition

Species composition of zooplankton recorded at Adimalathura Estuary is shown in Table 1. Zooplankton recorded the members of Foraminifera, Ciliate, Hydrozoa, Cheatognatha, Cladocera, Copepoda, Mysidaceae, Amphipoda, Cumaceae, Decapoda, Pteropoda and Larvalforms.

A total of 100 zooplankton were identified as 13 species of Foraminifera, 31 calanoida,8 Harpacticoida,10 cyclopoda, 2 Doliolioda,3 Appendicularia, 2 Decapoda, 2 Sagittoida, 4 Coelenterata, 1 Pteropoda, 2 Cladocera, and 15 larval forms

B. Percentage composition

In Adimalathura Estuary Calanoida formed the dominant group (34%) followed by larval forms (16%), Foraminifera (14%), Cyclopoida (11%), Harpacticoidea (9%), Coelenterata (4%), Appendicularia (3%), Cladocera (2%), Decapoda (2%), Doliolioda (2%), Sagittoida (2%), and Pteropoda (1%)

C. Population density

In station 1, zooplankton population density varied from 19,986 to 21,8100 organisms 1^{-1}.Minimum (19,986 organisms 1^{-1}) was recorded during the month of November and the maximum (21,8100 organisms $1^{-1}1$) during the summer season in April.

D. Species diversity

Diversity index (H') varied from 5.14 to 6.18. Minimum (5.14) was recorded during the month November and the maximum (6.18), during the summer season in April.

E. Species richness

Species richness (SR) varied from 0.62 to 1.48.Minimum (0.62) was recorded during the month of November and the maximum (1.48), during the summer season in May.

F. Species evenness

Species evenness varied from 1.55 to 1.89.Minimum (1.55) was recorded during the month of November and the maximum (1.89),during the summer season in March.

Estuaries of India were studied (Perumal *et al.,* 1998; Rajkumar et al. (2003), Gowda *et al.,* 2001; Gopinathan *et al.,* 2002). However few works have been made in immensive environment (Sundaraj and Krishnamoorthy, 1973; Kaliyaperumal 1992). But the present investigation focuses the attention on the population density, diversity, richness and evenness of zooplankton and secondary productivity in the two different estuary (Southeast coast of India).

Zooplankton recorded in the present study consisted of a total of 100 organisms including larvae (Table 1). The order abundance is of various groups such as Copepoda, Larvae, Ciliata, Ichthyoplankton, Cladocera, Rotifera, Hydrozoa, Salipida, Doliolida, Amphipoda, Mysids larvae, Polychaete larvae, Cumacea, Decapoda, Chaetognatha, Pteropoda and Foraminifera.

Abundance of various zooplankton in the coastal areas is being fluctuated in accordance with salinity regime. Among the various groups, copepods formed a predominant group with a total number of 59 species, to which the calanoids contributed the bulk of copepods followed by cyclopoids and harpacticoids and the important recorded forms were: Acartia (*Acartiaclause, A.spinicauda, A.southwelli*, *A.erythraea, A.danae,* and *A.centrura*) and *Oithona brevicornis, O.rigida, O.similes, O.spinirostris* and *O.linearis* (found in at all the three stations). Among, the harpacticoid copepods, *Euterpina acutifrons, Microsetella norvegica,* and *Macrosetell agracilis* were present throughout the study period at all three stations. Also *Acrocalanus gibber, A.gracilis, Paracalanus parvus* and *A.spinicauda* were common forms found in all three stations, which might be due to their ability to adapt the prevailing environmental conditions and also due to the continuous breeding behavior of the species. Similar opinion was earlier given by Sarkar et al. (1986), Kowenberg (1993); Neelam Ramaiah and Vijayalakshmi Nair (1997).

Copepods were found to be numerically abundant throughout the study period at all stations. Similar copepods abundance was also earlier recorded by Saraswathi (1993) from Arasalar and Kaveri estuaries, Ananthan (1991) from Pondicherry coast, Abidi et al. (1983) from Akarpati (Navapur) coast,

Gajbhiye and Desai (1981) in polluted and unpolluted regions of Bombay waters, Padmavathi and Goswami (1996) in Mandovi-Zuari estuarine system of Goa, With the onset of southwest monsoon (July-October), salinity dropped down and the population density also declined (Bhunia and Choudhury,1982).The important factors that controlled the distribution of copepods were rainfall and salinity, as suggested by Bijoy Nandan and Abdul Azis (1994).

Tintinnids showed a wide range of salinity tolerance and recorded high during summer, which might be due to the influence of neritic waters. These results are in agreement with the previous finding of Chandran (1982), Damodara Naidu et al. (1997) and Santhanam (2003) from Vellar estuary. Lucifer hanseni representing decapoda was recorded at all three stations. This is in conformity with the finding of Rajasegar (1998) from velar estuary.

The meroplanktonic organisms such as bivalve veliger, gastropod veliger, copepodnauplii and cirripednauplii were commonly available in Kodiayakkarai coastal waters. The fish larvae were also found to be common in all stations in the present study. It indicates that the coastal ecosystem serves as a breeding and nursery grounds for a variety of fishes. The higher zooplankton density recorded during summer season might be due to the relative stable environment condition, which prevailed during this season, and great neritic element presence from adjacent sea could have also contributed to the maximum density of zooplankton. Further, salinity is the key factor influencing zooplankton distribution and abundance (Padmavathi and Goswami, 1996).

Zooplankton population density was low during monsoon season due to the hydrographically washable environmental conditions. The monsoonal flow causes great depletion in zooplankton population density. Padmavathi and Goswami (1996) and Ananthan (1991) report that the heavy rain altered the salinity, temperature and other environmental variables which in turn decrease the zooplankton density. Further, the higher population densities of zooplankton observed during summer were coincided with the peak of phytoplankton density. The phytoplankton density showed positive correlation with zooplankton density. Further, higher population density with more number of copepod species were also observed by Rajagopalan et al. (1992).

Maximum species diversity of zooplankton was recorded during monsoon season at all three stations. The high values of zooplankton species diversity were found to be associated with the high zooplankton density that also indicated the stable high salinity and phytoplankton density. It is supported by the negative correlation value obtained between richness and evenness (r=0.502).The low species diversity was observed during month of November which could be attributed to heavy rainfall influx and low salinity. Rajkumar et al. (2006) have obtained similar values from Pitchavaram mangroves. The maximum value of evenness was noticed during monsoon and summer and the minimum values during monsoon similar type of high evenness values were recorded earlier by Rajasegar (1998) from Vellar estuary and from Uppanar estuary by Murugan (1989). The maximum richness value was recorded during summer and the minimum richness was during monsoon and monsoon seasons, as reported earlier by Rajasegar (1998) from Vellar estuary and from Uppanar estuary by Murugan (1989). The statistical correlation values of evenness showed positive correlation with species richness and species diversity.

Table 1 : Species recorded during 2013 to 2014 at Adimalathura Estuary

S. No	Name of the species	
	Foraminifera	
1	*Globigerina rubescense*	+
2	*G.bulloides*	+
3	*Tintinnopsis cylindrical*	-
4	*T.beroidea*	+
5	*T.butschii*	+
6	*T.tocantinensis*	+
7	*T.tubulosa*	+
8	*T.minuta*	+
9	*T.brindle*	+
10	*T.bermudensis*	+
11	*Eutintinnustenuis*	+
12	*Dictyocystaseshaiyia*	+
13	*Codonellopsisostenfeldii*	+
14	*Favellaphillpnensis*	+
15	*F.brevis*	+
16	*Rhabdonellalohmanni*	-
	Calanoida	+
17	*Nannocalanus minor*	+
18	*Canthocalanus pauper*	+
19	*Eucalanuselongates*	+
20	*Eucalanusmonachus*	+
21	*Calaonopia minor*	+
22	*C.aurivilli*	+
23	*Metacalanusaurivilli*	+
24	*paracalanusparvus*	+
25	*Acrocalanus gibber*	+
26	*A.gracilis*	+
27	*Centropagesfurcatus*	+
28	*Canthocalanus pauper*	-
29	*Pseudodiaptoimusaurivilli*	+
30	*P.serricaudatus*	+

31	*Labidocerapavo*	+
32	*L.acuta*	+
33	*L.pectinata*	+
34	*Euchaetawolfendeni*	+
35	*Pontelladanae*	+
36	*P.spinipes*	+
37	*P.securifer*	+
38	*Pontellopsisherdmani*	+
39	*P.scotti*	+
40	*Acartiaspinicauda*	+
41	*A.erythraea*	+
42	*A.danae*	-
43	*A.clausi*	+
44	*A.centrura*	+
45	*Tortanusbarbatus*	+
46	*Temoraturbinate*	+
47	*T.stylifera*	+
48	*T.discudata*	+
	Harpacticoidea	
49	*Miraciaefferata*	+
50	*Clytemnestra scutellata*	+
51	*Microsetellarosea*	+
52	*Microsetellanorvegica*	+
53	*Macrosetellagracilis*	+
54	*Macrosetella sp.*	+
55	*Euterpinaacutifrons*	+
56	*Metis jousseamei*	+
	Cyclopodia	
57	*Oithonarigida*	+
58	*O.brevicornis*	+
59	*O.similis*	+
60	*O.spinirostris*	+
61	*Oncaeavenusta*	-
62	*O.conifera*	+
63	*Corycaeuscatus*	+
64	*C.danae*	+
65	*Copelia mirabilis*	+
66	*Sapphirinaovatolanceolata*	+
	Doliolida	
67	*Doliolumcoioides*	+
68	*Salpafusiformis*	+
	Appendicularia	
69	*Oikopleuraparva*	+
70	*O.dioica*	+
71	*Fritillaria sp.*	+
	Decapoda	
72	*Lucifer hanseni*	+
	Sagittoida	
73	*Sagittaenflta*	+
74	*Sagittabipunctata*	-
	Coelentrata	
75	*Diphyes sp.*	+
76	*Aurelia aurita*	+
77	*Porpitaporpita*	+
78	*Bougainvilluia sp.*	+
	Pteropoda	
79	*Creeissp*	+
	Cladocera	
80	*Penilia sp.*	-
81	*Evadne sp.*	+
	Larval forms	
82	*Mysis larvae*	+
83	*Crustacean nauplii*	+
84	*Copepod nauplii*	+
85	*Barnacle nauplii*	+
86	*Shrimp zoea*	+
87	*Crab zoea*	+
88	*Euphasidzoea*	+
89	*Alima larvae*	+
90	*Gastropod veliger*	+
91	*Bivalve veliger*	+
92	*Polychaete larvae*	+
93	*Cyphonautea larvae*	-
94	*Phyllosoma larvae*	+
95	*Ophiopluteus larvae*	+
96	*Ophiothrix larvae*	+
97	*Bipinnaria larvae*	+
98	*Megalopa larvae*	+
99	*Gastropod veliger*	+
100	*Fish larvae*	+

IV. CONCULSION

The results of the present study showed that a combination of factors influence the zooplankton distribution and abundance in Adimalathura Estuary of south west coast of India. Among the various factors examined, abrupt changes in salinity caused by rainfall can be considered as the most important water quality parameters which affect zooplankton abundance as reported previously by many works. The study has proved that Adimalathura Estuary waters are relatively unpolluted with rich zooplankton diversity.

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