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ORIGINAL RESEARCH ARTICLE

Hydrobiological Investigations on the Planktonic Diversity of Vellar River, Vellar Estuary and Portonovo Coastal Waters, South East Coast of India

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ABSTRACT

The studies on planktonic diversity of Vellar River, Vellar estuary and Portonovo coastal waters, and South East of India were made to assess the pollution of water during the period of 2005-2006. The quantitative and qualitative evaluation of the variation in water showed that high quantity of phytoplankton population throughout the study period *Euglypha* sp., *Brachionus* sp., *Brachionus calciflorus*, *Brachionus rubens*, *Euchlanis dilita*, *Flling longiseta*, *Lecane bulla*, *Cyclops* sp., and showed the dominated group of organisms. The Vellar River through the high polluted water bodies by the direct contamination of sewage and other industrial effluents.

Key words: Vellar River, Vellar estuary, Portonovo coastal waters, seasonal variations and phytoplankton population.

INTRODUCTION

Planktons are very sensitive to the environment they live in any alteration in the environment leads to the change in the plankton communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, plankton population observation may be used as a reliable tool for bio monitoring studies to assess the pollution status of aquatic bodies [1]. The study of plankton as an index of water quality with respect to industrial, municipal and domestic pollution has been reported earlier [2].

Estuaries are economically important ecosystems for fisheries in tropical regions [3] and they act as a transitional zone between land and sea [4]. Phytoplankton initiates the marine food chain, by serving as food to primary consumers like zooplankton, shellfish and finfish [5,6,7,8]. Biomass and productivity of phytoplankton in different size ranges are important factors regulating the productivity of higher tropic-level organisms. The pelagic algal communities make important contributions to the smooth functioning of estuarine ecosystem [3]. Phytoplankton species distribution shows wide spatio-temporal variations due to the differential effect of hydrographical factors on Individual species and they serve as good indicators of water quality including pollution [9]. Tropical aquatic ecosystems are the most productive areas with rich Zooplankton population [10,11]. Information on species diversity, richness, evenness and dominance evaluation on the biological components of the ecosystem is essential to understand detrimental changes in environs [12].

Zooplanktons which are ubiquitous in distribution form a vital link for turnover of organic matter and transfer from primary producers like diatoms to secondary consumers like fishes. The rate of zooplankton production can be used as a tool to estimate the exploitable fish stock of an area [13]. Zooplankton provides an important food source for larval fish and shrimp in natural waters and in aquaculture ponds. It has been reported that in many countries the failure of fishery was attributed to the reduced zooplankton especially copepod population [14]. The present investigation was carried out on the surface plankton population in the aquatic ecosystem of Vellar River. The industrial effluents from SIPCOT industries and around Cuddalore district reached to the Vellar estuary contain numerous toxic substances once entered into the Vellar River affecting the water quality. As a consequence, the plankton population of the Vellar River has been affected in terms of abundance and diversity. The present study was aimed to evaluate the plankton diversity as the water quality criteria with special reference

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to freshwater bodies polluted by various industries of SIPCOT industrial complex.

MATERIALS AND METHODS

Qualitative and Quantitative analysis of the plankton were always performed on fresh water bodies. Slow moving, generally abundant organisms such as rotifers, copepods were counted first. Counts were carried out using sub samples or total samples. The sub samples were then divided into 10 + 2 drops on a multi depression microscope slide. Planktons were observed under a light microscope at a magnification of 10x and 100x. In general, systematic identification was done at the level of highest taxa using standard keys [15,16,17].

RESULTS AND DISCUSSION

The microscopic suspended algae, phytoplankton, make up a major portion of the autotrophic component of the food chain in an aquatic ecosystem. The phytoplankton provide energy link between the physical environment and the animal and *microbial consumers*. In the present study, total of 14 phytoplankton species were identified of which *Scenedesmus* sp., *Pediastrum duplex, mycrocystis, Nitchia obtuse, Navicula viridula, Oscillatoria curricess* and *Oscillatoria limosa* identified in station 1, *Scenadesmus* sp., *Mycrocyslis, pinnularia, Gomphonema* sp., *Melosira* sp., *Navicula cyphocephda* and *Oscillatoria limosa* identified in station 2, and *Cymbella leptoceros, Pinnularia* sp., *Gomphonema* sp., *Melosira* sp., *Navicula cyphocephala* and *Oscillatoria limosa* identified in station 3 (**Table 1**).

[18] identified several phytotplankton species such as *Oscillatoria chalybea, Lyngbya nigra, Phormidium tenue, Phormidium, africanum, Phormidium molle, Phormidium laminosum, Nostoc commune, Nostoc punctiforme, Nostoc linckia, Nostoc spongiaeforme, Nostoc piscinale, Anabaena oryzae, Anabaena fertilissima, Anabaena nariculoides, Anabaena variabilis* and *Anabaena vaginicola* in the lake water located at Jawaharlal Nehru University Campus, New Delhi. [19] identified 127 species of phytoplankton of which *Ankistrodesmus spiralis, Scenedessmus bijungatus, Desmidium* sp., *Closterium* sp., *Eunotia undulata, Fragillaria capucina, Fragillaria crotonensis, Fragillaria construens, Navicula radiosa, Nitzachia auricularis, Synedra ulna, Merismopedia punctata, Merismopedia elegans, Microcystis aeruginosa* and *Oscillatoria proteus* are dominant species in their observations in two Himalayan rural lakes. [20] identified many phytoplankton species such as *Chlorococcum humicola, Chlorella vulgaris, Cosmarium margariatum, Kirchnernella lunaris, Closteridium moniliferum, Micratinium pusillum, Pediastrum tetras, Scenedesmus quadericauda, Zygnema globoseum, Cyclotella antiqua, Cymbella ruttneri, Fragillaria crotonensis, Diatoma vulgare, Navicula gracilis, Nitzschia palea, Amphora oralis, Melosira granulata, Synedra ulna, Surinella elegans, Surinella spendida, Stephenodiscus niagaral, Ceratium hirudinella, Peridinium gatunena, Microcystis aeruginosa, Merismopedia elegans, Oscillatoria limnetica, Lyngya limnetica, Pharmidium unicinatum, Nostoc muscorum, Anabaena flosaquae* and *Anabaenopsis raciborlkii*.

[21] identified 20 species of phytoplankton such as *Chlamydomonas ohioensis, pandorina morum, Eudorina elegans, Pleodorina californica, Pleodorina illinoisensis, Volvo spermatosphara, Scendesmus quadricauda, pediastrum boryanum, Selenastrum gracile, Chlorella* sp., *Closterium moniliferum, Coelosphaerium kutzingianum, Oedogonium crenulata, Eudorina elegans, Ulothrix zonata, Desmidium Schwartzii, Chara fragilis, Cladophora glomerata, Oscillatoria prolifica* and *Spirogyra crassa* have been identified in the lake water located at Perambalur. [22] identified 66 species of phytoplankton in the Nanthanar Pond water, 37 species in the Ganaprakasam pond water, 63 species in the Thillaikaliamman pond water, 47 species in the Vellakulam pond water and 41 species in the Omakulam pond water. The dominant species in his observation were *Chlorococcum infusionum, Chlorella vulgaris, Closberidium parvulum, Cosmarium contractum, Cosmarium Pseudobiremum, Pandorina morum, Scenedesmus quadricanda, Spirogyra paravala, Scenedesmus quadricausda, Selenastrum gracile, Cyclobella stelligera, Navicula Krasskei, Navicula viridula, Synedra ulna, Euglena acus, Euglena granulata, Euglena pisciformies, Euglena viridis, Microcystis elebans, Microcystis protocystics, Oscillatoria obscura* and *Oscillatoria curviceps*.

Generally variations in phytoplankton species composition and their production in fresh water bodies like ponds and lakes are due to the influence of some factors such as isolation, availability of nutrients, biomass, grazing and other environmental parameters. [23] suggested that the seasonal distribution of phytoplankton is

influenced by the availability of inorganic nitrogen and phosphorus. [24] stated the blue-green algae are predominant during low photoperiod and the green algae are predominant during high photoperiod and carbon dioxide concentration. Further a total of 44 zooplankton species such as *Arella discoidae, Arella Vulgaris, Difflugia* sp., *Euglypha* sp., *Vorticella* sp., *Anuracopris fissa, Brachionus, Brachionus calciflorus, Brachionus quadridentanus, Brachionus rubens, Euchlanis dilita, Filina longiseta, Kertalla cochlearie, Lecane bulla, Lecane luna, Monostyla bulla, Synchacta* sp., *Mytilina* sp., Nauplius larva, *Cyclops* sp., *Diatoms* sp., *Mesocyclops hyaliners, Oneaca venust, Oithona brevicornis, Oithona simplex, Bosmina longirasttris, Cerioda pheriereticulata, Chyderinae* sp., *Chydornus* sp., *Daphnia carinata, Moina micrura, M. brachiata, Cypridapsis dispa, Cypris protubera, Cypris* sp., *Eucypris bispinosa, Halocypris brerirostris, Hetero cypris. Postomocypris, Culex* sp., *Corixa* sp., *Helocharus lividus, Tipula* sp. are identified in the present investigation. Among the species identified *Arella discodae, Arecella vulgaris, Difflugia* sp., *Anuracopris asissa, Synchocta* sp., *Oneaca venusta, Oithona simplex, ceriodapheriereticulata, Chyderinae* sp., *Chydornus* sp., *Moina brachiata, Cypridepsis dispar, Halocypris brerirostris, Hetro Cypris, Corixa* sp., *Helocharus lividus* and *Tipula* sp. not identified in station 1, *Difflugia* sp., *Vorticella* sp., *Brachionus quadridentanus, Kertalla, cochlearies, Monostyla bulla, Nauplius larva, Mesocyclops hyaliners Chyderinae* sp., *Moina micrura, Cypris protubera, Cypris* sp. further *Diatoms* sp., *Alona quadrangulars, Corixa* sp., *Tipula* sp. Not identified in station 3 (**Table 2**).

[25] identified 21 species of zooplankton of which *Keratella cochlearis, Keratella quadrata, Bosmina longirostris, Ceriodaphnia locustris, Daphnia amtrigua, Daphnia porvula, Leyciga quadrangularis* and *Mesocyclops* sp. are dominant species in an ice-covered lake. [19] identified several species of zooplankton namely *Asplanchna brightweelli, Asplanchnonus multiceps, Brachionus cawdatus, Euchlaris dilatata, Keratella quadrata, Keratella cochlearis, Lecane elechis, Lepadella ovalis, Monostyla lunaris, Mytilina ventralis, Notholca accuminata, Trichocera procellus, Alona rectangula, Bosmina longirostris, Cydorus sphaericus* and *Cyclops vicinus* in two Himalayan rural lakes. [26] identified seven species of zooplankton *viz*., *Brachionus rubens, Brachinus* sp., *Mesocyclops* sp., *Moina* sp., *Daphnia* sp., *Nauplius* and Metanauplius in a pond water at Madras.[27] identified two species of zooplankton namely *Arctodiaptomus altissimus* and *Hexarthra bulgarica* in the Himalayan lake water at Central Nepal.

[28] identified several zooplankton species such as *Ceriodaphnia cornuta, Bosmina longirostris, Chydorous sphaericus, Diaphonosoma* sp., *Diaptomus nudus, Mesocyclops leckarti, Thermocyclops Nylinus, Nauplius, Brachionus forficula, Brachionus diversicornis, Brachionus calyciflorus, Brachionus falcatus, Keratella cochlearis, Keratella tropica, Keratella faculata, Trichocerca similis, Asplanchna brightwelli, Filinia opaliensis, Chromogaster* sp., *Polyphemus* sp. and *Eubranchipus* sp. in the upper lake water at Bhopal, Madhiya Pradesh. [29] identified *Brachionus* sp., *Cephallodella* sp., *Keratella* sp., *Lecane* sp., *Lepadella* sp., *Monostyla* sp., *Trichoria* sp., *Cyclops* sp., *Nauplius* and *Paramoecium* sp. in the Shivabari temple tank water at Bikaner.

[22] identified 22 Zooplankton species *viz*., *Daphnia* sp., *Alona quadrangularis, Chydorus* sp., *Polyphenus pediculus, Ceriodaphnia, Bosmina longirostris, Nauplius, Mesocyclops, Diaptomus minutus, Trochocyclops* sp., *Ceratium* sp., *Filina* sp., *Lapadella* sp., *Brachionus rubens, Polyarthra vulgaris, Keratella taurocephala, Kellicottia longispina, Amoeba* sp., *Metapus* sp., *Paramoecium* sp. and *Vorticella* sp. in the Gnanaprakasam temple pond water at Chidambaram. [21] identified 11 zooplankton species *viz*., *Amoeba proteus, Difflugia urceolata, Paramoecium caudatum, Frontonia leucas, Microcoidides robustus, Philodina roseola, Aspeanchnopus myrmeleo, Brachionus pala, Daphnia longispina, Daphnia pulex,* and *Nowplius* in the lake water located at Perambalur, Tamilnadu. Zooplanktons play a major role in maintaining the tropic level in the aquatic ecosystem through their remineralization which leads to nutrients recycling and thereby regulating phytoplankton population density. Some reports suggested that the zooplankton release some quantities of inorganic nutrients which in turn utilized by phytoplankton for their blooms. Zooplankton productivity in the fresh water bodies is influenced by various physico-chemical parameters.

Phytoplankton and zooplankton constitute the main food of fish and fish larvae and thus phytoplanktons have a direct bearing on the

secondary and tertiary producers [30]. The zooplankton mainly comprised of Protozoa, Rotifers, Copepods, Cladocerans. Ostracods and Insecta. Among the groups, Rotifers were the largest contributor in terms of density (33%) followed by Cladocerans (18%) Protozoa (16%) Copepods (11%). Ostrocods (7%) and insecta (15%) in station 1. With regards to station 2, Rotifers (34%) Copepods (25%) Protozoa (18%) Cladocerans (13%) and Ostracods and Insecta (5%) observed . Rotifers constituted 34%, Cladocerans 25%, Protozoans 18%, Copepods 13%, Ostracods and Insecta each 5%, observed in station 3. The phytoplankton mainly comprised of the group Chlorophyceae (31%). Bacillariophyceae (40%) and Cyanohyceae (20%) in station 1, followed by Cyanophyceae (52%) Bacillariophyceae (40%) and Chlorophyeae (8%) in station 2, and Bacillariophyceae (40%) Chlorophyceae (32%), and Cyanophyceae (28%) in station 3. The wide distribution, spatial abundance of phytoplankton and zooplankton mainly depend upon the ecological parameters, consumers (users), dilution factors by rainfall and water quality without pollution.

Table 1: A list of identified phytoplankton species in the study area during 2009-10

S.No	Phytoplankton species	Stations		
		1 Vellar river	2 Vellar estuary	3 P. coastal area
1	*Scenedesmus* sp.	+	+	-
2	*Pediastrum duplex*	+	-	-
3	*Mycrocystis*	+	+	-
4	*Cymbella leptoceros*	-	-	+
5	*Nitchia obtuse*	+	-	-
6	*Pinnularia* sp.	-	+	+
7	*Gomphonema* sp.	-	+	+
8	*Melosira* sp.	-	+	+
9	*Navicula cyphocephala*	-	+	+
10	*Navicula capsidala*	-	+	-
11	*Navicula viridula*	+	-	-
12	*Chytridium*	-	+	-
13	*Oscillotoria curricess*	+	+	-
14	*Oscillotoria limosa*	+	-	+

+ = presence; - = absence

Table 2: A list of identified Zooplankton species in the study area during 2009-10

S.No	Zooplankton Species	Stations		
		1 Vellar river	2 Vellar estuary	3 P. Coastal area
	Protozoa			
1	*Arella discoidae*	-	+	+
2	*Arella vulgaris*	-	+	+
3	*Difflugia* sp.	-	-	+
4	*Euglypha* sp.	+	+	+
5	*Vorticella* sp.	+	-	+
	Rotifers			
6	*Anuracopris fissa*	-	+	+
7	*Brachionus* sp.	+	+	+
8	*Brachionus calciflorus*	+	+	+
9	*Brachionus quadridentanus*	+	-	+
10	*Brachionus rubens*	+	+	+
11	*Euchlanis dilita*	+	+	+
12	*Filina longiseta*	+	+	+
13	*Kertalla cochlearies*	+	-	+
14	*Lecane bulla*	+	+	+
15	*Lecane luna*	-	+	+
16	*Monostyla bulla*	+	-	+
17	*Synchacta* sp.	-	+	+
18	*Mytilina* sp.		+	+
	Copepods			
19	Nauplius larva	+	-	+
20	*Cyclops* sp.	+	+	+

21	*Diatoms* sp.	+	+	-
22	*Mesocyclops hyaliners*	+	-	+
23	*Oneaca venusta*	-	+	+
24	*Oithona brevicornis*	+	+	+
25	*Oithona simplex*	-	+	+
	Cladocerans			
26	*Alona quadrangulars*	+	+	-
27	*Bosmina longirasttris*	+	+	+
28	*Cerioda pheriereticulata*	-	+	+
29	*Chyderinae* sp.	-	-	+
30	*Chydornus* sp.	-	+	+
31	*Daphnia carinata*	+	+	+
32	*Moina micrura*	+	-	+
33	*Moina brachiata*	-	+	+
	Cladocerans			
34	*Cypridapsis dispar*	-	+	+
35	*Cypris protubera*	+	-	+
36	*Cypris* sp.	+	-	+
37	*Eucypris bispinosa*	+	+	+
38	*Halocypris brerirostris*	-	+	+
39	*Hetero cypris*	-	+	+
40	*Postomocypris* sp.		+	+
	Insecta			
41	*Culex* sp.	+	+	+
42	*Corixa* sp.	-	+	-
43	*Helocharus lividus*	-	+	+
44	*Tipula* sp.	-	+	-

+ = presence, - = absence

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