ORIGINAL RESEARCH PAPER

Zoology

KEY WORDS:

DISTRIBUTION, ABUNDANCE AND SPECIES DIVERSITY OF PHYTOPLANKTON IN THE INSHORE WATERS OF MIRKARWADA, RATNAGIRI, WEST COAST OF INDIA.

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INTRODUCTION

Phytoplankton in a marine environment is an important biological indicator of the water quality. They constitute the basis of food chain composition in aquatic environment as they play the role of primary producer and serve as food for aquatic animals such as zooplankton, shellfish and finfish (Gowda et al. 1992, Tiwari and Chauhan, 2006 and Perumal et al. 2009) and also play an important role in maintaining the biological balance and quality of water. Its study includes a variety of taxonomic groups (cyanobacteria, diatoms, dinoflagellates, silicoflagelates, coccolithophorids, and many other flagellates) that inhabit the water column. Marine phytoplankton of the world may include as many as 14 classes and an estimated number of 498 ± 15 genera and 3,910 ± 465 species (Sournia *et al.* 1991). Through the process of photosynthesis, phytoplankton also extracts carbon dioxide from the atmosphere, and plays an important role in the balance of greenhouse gases that control global climate (Alles, 2011). Phytoplanktons are the skeletons of food web dynamics, which control many ecological processes such as carbon budget, modulation of sea surface temperature(SST) affecting global climate. They are very efficient and easily detectable indicators of ecological alteration. Presence of certain species of phytoplankton can trigger the fishery or deplete it also resulting in toxicity.

Ratnagiri is located on the western coast of Maharashtra and seems to be economically backward area in Maharashtra. Hence, very little attention has been paid to the scientific studies along this coast. It is also known as paradise of Maharashtra and very popular for its scenic beauty and land of sun and sand and off course travelers' delight. The study area, Mirkarwada is situated at 17^{0}North and 73^{0}East and having an area of about 50,209 sq miles. It is one of the famous landing centers not only in Ratnagiri but in state of Maharashtra. The coastline of Ratnagiri district is 250 miles long and marked with several islands, which is a result of drowned topography. Ratnagiri coast has been blessed with luxuriant, thick mangrove vegetation with patches of other associated flora and fauna. Life in the sea consist of three major groups of organisms namely plankton, nekton, and benthos. Among these plankton is one of fundamental importance to fisheries. The name comes from the Greek terms, *phyton* or "plant" and *planktos*, meaning "wanderer" or "drifter". Phytoplankton is microscopic plants that live in the ocean, freshwater and other terrestrial based water systems(Patil *et. al.* 2011, Patil and Ghorade, 2012).The Planktons are composed of tiny plant called phytoplankton. Plankton is primarily divided into broad functional groups: Phytoplankton and Zooplankton. This scheme divides the plankton community into broad producer and consumer groups.

Marine species of phytoplankton grow abundantly in oceans around the world and are the foundation of the marine food chain. Marine Phytoplankton is the producing (autotrophic) component of the ocean. Phytoplankton is often an important link in the transformation of energy in ecosystem (Bhadran, 2001) and plays an important role to make climax community. It acts as an indicator to pioneer community.

Significance of Phytoplankton:

In marine environment diatoms are the important group of phytoplankton engaged in primary production. Distribution and abundance of diatoms indicate a conducive environment for active growth and survival of other forms of lives. In many cases population density of marine animals and their reproductive cycle are related to the abundance of phytoplankton. This is because those animals themselves and/or their metamorphosing young ones (larvae) are dependent on diatoms, dinoflagellates *etc*. for nutrition (Borse *et al.* 2000). Quite a few of these organisms such as barnacles, mussels, oyster's tube worms etc. are active bio fouling forms. In addition, high plankton density is associated with similar increase in bacterial population mainly involved in decomposition of particulate organic matter from fecal pellets and the bodies of dead organisms. Hence the species diversity and abundance of the community structure of the phytoplankton is necessary to assess the potential fishery resource of a place (Varadharajan *et al*., 2009). In view of this, the present study was carried out at Mirkarwada to study the abundance and species diversity of marine phytoplankton so as to explore its fishery potential.

MATERIALS AND METHODS:

Study Area-

The present study was carried out at Mirkarwada costal area of Ratnagiri. Considering the nature of study area, three zones were selected sampling. Sampling was done for two years one *i.e.* October 2014 to May 2016, fortnightly covering intermediate phase of the tide to avoid tidal effect, if any occurs. Total 13 samplings were completed each year. Diesel engine boat was used to reach different sites of Mirkarwada. After reaching to study sites the water samples for phytoplankton analysis were collected with help of Niskin sampler (the instrument used to collect water sample from different depth).The water sample were taken from 0m depth to 50m depth. About 5 liter water was collected and filtered with the help of sieves having pore size 10µ and then the filtered water was collected into sterile plastic bottles and later on it was preserved in 5 % neutralized formaldehyde solution and Lugol's solution(Sharma *et al.* 2009).The systematic identification of planktons was made by standard books on Phytoplankton of Indian seas.

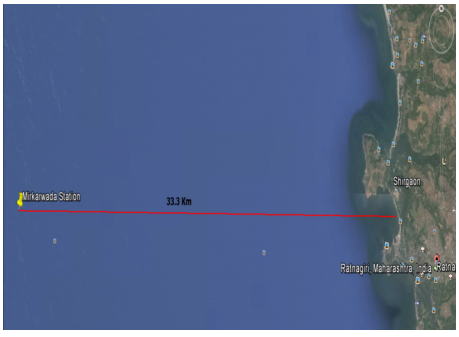


Fig. 1 Map of study area Mirkarwada.

RESULTS AND DISCUSSION:

The present investigation deals with the phytoplankton density of the aquatic environment. Most of the algae were planktonic4, free floating and few are epizoic. In the present work at Mirkarwada station of Ratnagiri sea coast total 134 species of phytoplankton were recorded which belongs to 63 genera which comprised of the Bacillariophyceae -34, Dinophyceae – 12, Coscinodis cophyceae – 06, Mediophyceae – 03, Pyrophyceae and Chrysophyceae – 02 Chlorophyceae,Cyanophyceae, Prasinophyceae and Rhodophyceae - 01. The detail phytoplankton classification is shown in table-1. Checklist of phytoplankton of Mirkarwada station of Ratnagiri in Year 2014-15 and 2015-16 is

shown in table- 2 and 3.Percentage of phytoplankton shown in figure No. 2.

Table No. 1 Classification of Phytoplankton

Sr No	Class of phytoplanktons	Genera obtained	Species recorded
1	Bacillariophyceae	34	60
2	Chlorophyceae	01	01
3	Chrysophyceae	02	03
4	Coscinodiscophyceae	06	08
5	Cyanophyceae	01	01
6	Dinophyceae	12	25
7	Mediophyceae	03	04
8	Prasinophyceae	01	01
9	Pyrophyceae	02	30
10	Rhodophyceae	01	01
	Total	**63**	**134**

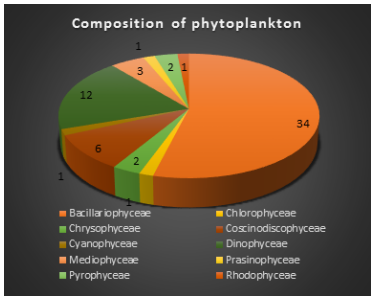


Figure 2: Percentage of Phytoplankton

Table No 2 : Checklist of phytoplankton of Mirkarwada coast, Ratnagiri (2014-15)

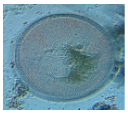
Sr. no.	Species of phytoplankton	Post monsoon	Winter	Summer
	Bacillariophyceae			
1	*Skeletonema*	++	++	+
2	*Cyclotella*	++	+	-
3	*Planktoniella*	+	+	+
4	*Leptocylindrus*	+	+	+
5	*Guanardia*	+	+	+
6	*Rhozosolenia*	+	++	++
7	*Bactrriastrum*	++	++	+
8	*Chaetoceros*	++	++	++
9	*Eucamphia*	+	+	-
10	*Climacodium*	+	-	-
11	*Ditylum*	+	+	+
12	*Triceratium*	-	+	+
13	*Bidulphia*	+	+	+
14	*Rhabdonema*	-	+	-
15	*Flagileria*	-	+	-
16	*Thalassionema*	++	++	++
17	*Thalassiothrix*	+	-	-
18	*Asterionella*	+	+	+
19	*Plurosigma*	++	+	+
20	*Gyrosigma*	-	+	-
21	*Navicula*	+	+	+
22	*Amphiprora*	-	-	+
23	*Amphora*	-	-	-
24	*Cymbella*	+	+	+
25	*Nitzschia*	+	+	+
26	*Fiagilariopsis*	+	+	-
27	*Aulocodiscuss*	+	+	-
28	*Diploneis*	+	-	-
29	*Haslea*	+	-	-
30	*Pseudonitzschia*	+	+	-
31	*Surirella*	+	-	-
32	*Synedra*	+	-	-
33	*Thalassiosira*	+	+	-
34	*Asterionellopsis*	+	-	-
	Chlorophyceae			
1	*Chlorella*	+	+	+
	Pyrophyceae			
1	*Peridinium*	+	+	+
2	*Ceratium*	++	++	++
	Dinophyceae			
1	*Dinophysis*	+	+	+
2	*Ornithocercus*	+	+	+
3	*Amphisolenia*	-	-	-
4	*Goniaulax*	-	+	-
5	*Gymnodium*	-	-	-
6	*Noctiluca*	-	+	+
7	*Oxytoxum*	-	+	+
8	*Phalacroma*	-	+	-
9	*Podolampus*	-	+	-
10	*Prorocentrum*	+	+	-
11	*Pyrophacus*	+	+	-
12	*Pyrocystis*	+	+	-
	Cyanophyceae			
1	*Trichodesmium*	-	-	-
	Chrysophyceae			
1	*Dictyocha*	++	++	++
2	*Octactis*	+	+	+
	Prasinophyceae			
1	*Micromonas*	-	-	-
	Rhodophyceae			
1	*Bracilariopsis*	-	-	-
	Mediophyceae			
1	*Ceratulina*	-	-	-
2	*Lauderia*	-	-	-
3	*Minidiscuss*	-	+	-
	Coscinodiscophyceae			
1	*Coscinodiscuss*	++	++	++
2	*Actinotychus*	+	+	+
3	*Asteromphalus*	-	+	-
4	*Corenthron*	+	+	-
5	*Dactyliosolen*	-	-	-
6	*Stephanopyxis*	-	+	-

Table No 3 : Checklist of phytoplankton of Mirkarwada coast, Ratnagiri (2015-16)

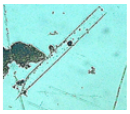
Sr no	Species of phytoplankton	Post monsoon	Winter	Summer
	Bacillariophyceae			
1	*Skeletonema*	+	+	+
2	*Cyclotella*	+	+	-
3	*Planktoniella*	+	+	+
4	*Leptocylindrus*	+	+	+
5	*Guanardia*	+	-	+
6	*Rhozosolenia*	++	++	++
7	*Bactrriastrum*	++	++	+
8	*Chaetoceros*	++	++	++
9	*Eucamphia*	+	-	-
10	*Climacodium*	-	+	-
11	*Ditylum*	+	+	+
12	*Triceratium*	+	-	-
13	*Bidulphia*	+	+	+
14	*Rhabdonema*	-	+	-
15	*Flagileria*	+	-	-

16	*Thalassionema*	++	++	++
17	*Thalassiothrix*	-	+	+
18	*Asterionella*	+	+	+
19	*Plurosigma*	+	+	+
20	*Gyrosigma*	-	-	-
21	*Navicula*	+	+	+
22	*Amphiprora*	-	-	+
23	*Amphora*	+	-	-
24	*Cymbella*	+	+	+
25	*Nitzschia*	+	+	+
26	*Fiagilariopsis*	-	-	-
27	*Aulocodiscuss*	-	-	-
28	*Diploneis*	+	-	-
29	*Haslea*	+	-	-
30	*Pseudonitzschia*	+	-	-
-31	*Surirella*	-	-	-
32	*Synedra*	-	-	-
33	*Thalassiosira*	+	-	+
34	*Asterionellopsis*	+	-	-
	Chlorophyceae			
1	*Chlorella*	+	+	+
	Pyrophyceae			
1	*Peridinium*	+	+	+
2	*Ceratium*	++	++	++
	Dinophyceae			
1	*Dinophysis*	+	+	+
2	*Ornithocercus*	+	+	+
3	*Amphisolenia*	-	-	-
4	*Goniaulax*	-	-	-
5	*Gymnodium*	-	+	-
6	*Noctiluca*	+	+	+
7	*Oxytoxum*	-	+	-
8	*Phalacroma*	-	+	-
9	*Podolampus*	+	+	-
10	*Prorocentrum*	-	+	+
11	*Pyrophacus*	-	-	-
12	*Pyrocystis*	-	-	+
	Cyanophyceae			
1	*Trichodesmium*	-	-	-
	Chrysophyceae			
1	*Dictyocha*	++	++	++
2	*Octactis*	+	+	+
	Prasinophyceae			
1	*Micromonas*	-	-	-
	Rhodophyceae			
1	*Bracilariopsis*	-	-	-
	Mediophyceae			
1	*Ceratulina*	-	-	-
2	*Lauderia*	-	-	-
3	*Minidiscuss*	-	-	-
	Coscinodiscophyceae			
1	*Coscinodiscuss*	++	++	++
2	*Actinotychus*	+	+	+
3	*Asteromphalus*	-	-	-
4	*Corenthron*	-	+	-
5	*Dactyliosolen*	-	-	-
6	*Stephanopyxis*	-	-	-

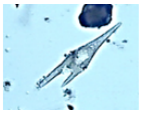
Bidulphia sp. *Planktoniella sp.* *Pleurosigma sp.* *Octactis sp.*



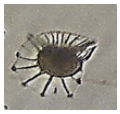
Coscinodiscus sp.



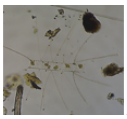
Rhizosolenia sp.



Ceratium s.

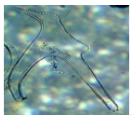


Ornithocercus sp.



Chaetoceros sp.

Guinardia sp.



Dinophysis sp.

Dictyocha sp.

From the present investigation it is clear that some genera like *Rhizosolenia, Chaetoceros, Coscinodiscus, Ceratium, Bacteriastrum, Thalassionema, Nitzschia*and Plurosigma were dominant in all the three seasons at Mirkarwada station. Other genera like *Navicula, Dictyocha, Actnotychus, Skeletonema, Leptocylindrus, Ornithocercus, Ditylum* and *Bidulphia* were also present in all three seasons but the density was reasonably little. *Eucamphia, Climacodium, Prorocetrum Flagilaria* genera were present in some specific season only. There was no much fluctuations in the occurrence of phytoplankton during two consecutive years.

The Group wise phytoplankton species were as given below -

Bacillariophyceae:

The group Bacillariophyceae constitutes the diatoms and it is characteristic feature of water bodies specially the costal water. Diatoms were represented by highest thirty-four genera and were dominant throughout the study period at Mirkarwada station. Diatoms are unicellular autotrophic organism and form about 90% of the phytoplanktons biomass (Subrahmanyan, 1967). In the present study they were constituted 53.96% of the total population and the maximum density of diatoms was recorded in month of October and November.

Dinophyceae:

The group Dinophyceae constitutes the dinoflagellates. Dinoflagellates are unicellular,single or pseudocolonial and show variation in morphology.The size of these organism ranges from 0.001 to 2mm. Dinoflagellates were represented by twelve genera. They were constituted 19.04% of total population. Maximum density of dinoflagellates was recorded during winter season.

CONCLUSION-

From this research investigation it is concluded that the Mirkarwada station supports highest density of phytoplankton with a diverse community.The phytoplankton community at Mirkarwada station mainly dominated by members of Bacillariophyceae throughout the period of investigation.The total plankton count was minimum during summer and winter and maximum in post monsoon period at the Mirkarwada station. Percentage contribution of each class of phytoplankton was in the order:

Bacillariophyceae > Dinophyceae > Cocsinodiscophyceae > Mediophyceae > Chrysophyceae > Pyrophyceae > Chlorophyceae > Cyanophyceae > Prasinophyceae > Rhodophyceae.Temporal variation in phytoplankton community composition suggested that different algal groups registered its peaks in different seasons. Such variations in the populations of different algal groups in relation to total density suggest that different species require different optimal conditions for their presence, survival and multiplication or growth (Reynolds, 1984; Palmer, 1980; Watson et al., 1997; Litchman et al., 2001). The present baseline information of the phytoplankton distribution and abundance would form a useful set of data for further ecological assessment and monitoring of the ecological sensitive coastal ecosystems of India.

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