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MICROALGAE POPULATION IN TWO SELECTED COASTAL ZONES IN SOUTH EAST COAST OF TAMIL NADU, INDIA

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ABSTRACT: Seasonal variation and diversity of microalgae were carried out in summer, winter and monsoon seasons during the year 2014 in Rameswaram (RA) and Tuticorin (TN), South East Coast of Tamil Nadu, India. A total of 53 phytoplankton species belonging to four groups namely diatoms, dinoflagellates, green algae and blue green algae were recorded at RA and TN sites. Diatoms were found to be the dominant group (30 species) followed by blue green algae (15 species), green algae (6 species) and dinoflagellates (2 species). The density of microalgae varied from 2000 cells/L to 68,000 cells/L and the maximum density was recorded during summer and the minimum in winter season.

KEYWORDS: Diversity, Microalgae, Pollution, Marine water.

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1. INTRODUCTION

Marine phytoplanktons are free floating organisms that play an important role in food chain and contribute to the primary productivity of the ocean. Seasonal pattern in phytoplankton diversity, composition, bio volume and importantly, the magnitude of primary production [15, 26]. It is used for the variation of marine ecological problems, such as per protection of biodiversity, bionetwork characters and services. Therefore, the phytoplanktons are involving the several ecological processes with influence the species diversity [27]. The composition of phytoplankton is varied based on the environmental and hydrological conditions as well as [3, 7, 9, 11] the chemical composition of water where they exist [2,4] reported that pollution affects the distribution, standing crop and chlorophyll concentration of phytoplankton; hence the phytoplanktons are of great importance in bio monitoring of pollution [5, 30, 31]. The plankton is an vital natural marker of the water quality. Plankton studies and observation are valuable for manage of the physico-chemical and biological environment of the water in any irrigation work [28, 29]. The objective of the present study was to compare the diversity of marine microalgae in a non-polluted site (Rameswaram) and polluted site (Tuticorin), in south east coast of Tamil Nadu.

2. MATERIALS AND METHODS

Study Area

The first study area, Rameswaram, falls within the geographical coordinate's 9° 13' 50° E and 79° 11' 55° N which is adjacent to Gulf of Manner Marine Biosphere reserve selected as control site. The second study area, Tuticorin falls within the geographical coordinate's 8° 46' 15° E and 78° 10' 7° N was selected as polluted site adjacent to the Tuticorin Harbour (Location Map).

Sample collection site

Microalgal samples were collected from Rameswaram (RA) and Tuticorin (TN) area southeast Coast of India (Figure.1). Gulf of Mannar in the southeast coast of India extends from Rameswaram Island in the north to Kanyakumari in the south. It has a chain of 21 islands stretching from Mandapam to Tuticorin to a distance of 140 km along the coast. Each one of the islands is located anywhere between 2 and 10 km from the mainland. The Gulf of Mannar was set up on 18th February 1989 jointly by the Government of India and the state of Tamil Nadu. The coastal location in Tuticorin is well known for pearl, fishery and shipbuilding. It is one of the important major Ports having a number ship movement. The movement of ships and fishing operation by mechanized boats also discharge oil effluents and petrochemical products into the sea. The Thermal power station straight dumps its ash into the sea.

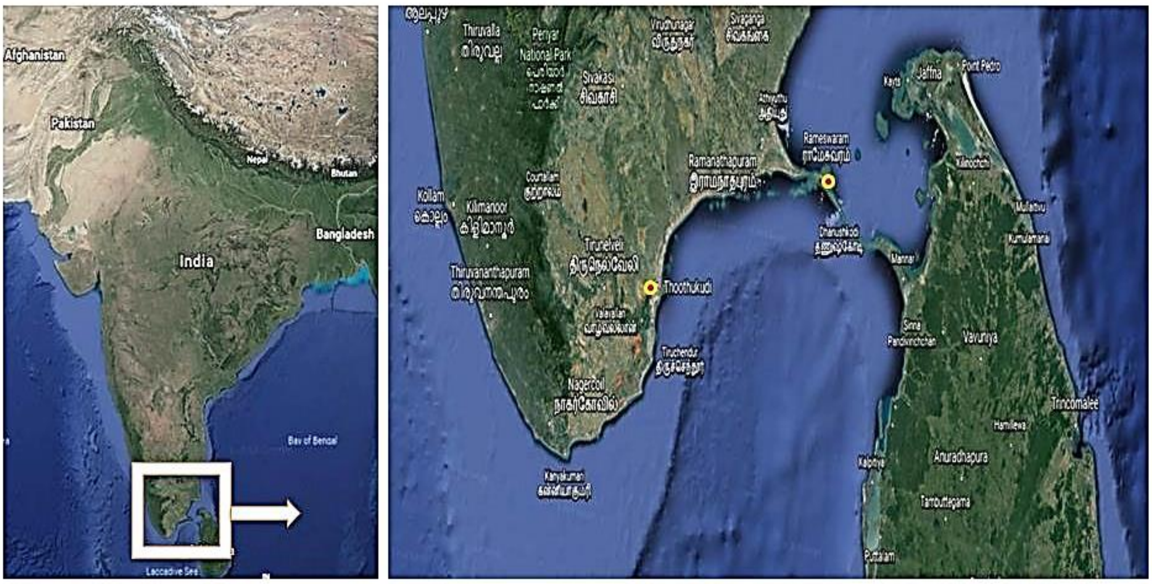

Figure 1: Sampling areas located in Rameswaram and Tuticorin of Southeast coast of Tamil Nadu, India

Sample Collection

Microalgae were collected from the surface waters in the study area during April 2014 - 2015. Samples were collected by towing plankton net (mouth diameter 45cm) made of bolting silk cloth (No.35mesh size 30/µm) for 20 minutes. The samples were stored in polythene bottles after preservation with Lugol's iodine solution (100:1). For the quantitative analysis of phytoplankton, the settling method as described by [38] was adopted. Numerical plankton analysis was carried out using Olympus microscope. Finally the sample was concentrated to 20 ml by decanting, and 1 drop of concentrated sample was added to Heamocytometer counting cell and were counted and identified according to standard monographs- Cyanophyta [39]. Fresh-Water Biology [40] and Indian Freshwater Microalgae [41- 49]

3. RESULTS AND DISCUSSION

This study recorded 53 species of microalgae belonging to four families' i.e. Bacillariophyceae (30), Dinophyceae (2), Cyanophyceae (15) and chlorophyceae (Table.1) *Actinoptychus splendens, Bacillaria paradoxa, Biddulphia rhombus, Odontella mobiliensis, Paralia sulcata, Trachynesis antillarus, Triceratium Robertianum, Oscillatoria foreaui, Oscillatoria minnesotensis, Cosmarium subtumidium, Pediastrum tetras* and *Scenedesmus armatus* occurred in Rameswaram site. Where as *Auliscus sculptus, Nitzschia vitrea, Triceratium dubium* and *Pediastrum simplex* occurred only in TN site. *Chroococcus minutus* and *Surirella nervatus* were occurred in both the sites in all seasons. The most dominant group among microalgae was Bacillariophyceae and it contributed about 51 % of the total microalgae population. Maximum density of diatom was reported (68,000 cells L^{-1}) during summer season followed by (62,000 cells L^{-1}) monsoon season. While a minimum density with 52,000 cells L^{-1} during winter season. In TN site maximum level of density during summer season (53,000 cells L^{-1}) followed by 45,000 cells L^{-1} in monsoon season while minimum (35,000 cells L^{-1}) during winter season. Maximum density of Cyanophyceae was recorded during summer (43,000 cells L^{-1}) at RA site followed by monsoon (37,000 cells L^{-1}). While minimum cell density reported in winter (29,500 cells L^{-1}) and maximum (32,000 cells L^{-1}) during summer season followed by (26,000 cells l^{-1}) during the monsoon season. Where as in TN minimum (21,000 cells l^{-1}) during the winter season. Chlorophyceaen members were the third dominant group with 7% of the total population of microalgae in the study area. In RA site maximum density was recorded during summer (15,000 cells L^{-1}) followed by monsoon (12,000 cells L^{-1}) and winter (11,500 cells L^{-1}) where as in TN site maximum density reported in (13,000 cells L^{-1}) during the monsoon followed summer (10,000 cells L^{-1}) and winter (7,000 cells L^{-1}). The fourth dominant group, Dinophyceae was represented by 3 species accounts for 4% of the total microalgae population. During summer seasons maximum density of cells was recorded (7,000 cells L^{-1}) in RA site followed by summer (6, 000 cells L^{-1}) and winter. In TN site the maximum density of microalgae recorded during summer (4,000 cells L^{-1}) followed by monsoon (3,000 cells L^{-1}) and winter (2,000 cells L^{-1}).

Table 1: Number of microalgae species and the percentage composition recorded at RA and TN in study area

Group	Number of species recorded			% composition
	RA	TN	Total	
Diatoms	26	17	43	51.80723
Blue-Green algae	12	15	27	32.53012
Green algae	5	4	9	10.84337
Dinoflagellates	2	2	4	4.819277
Total	45	38	83	100

Table 2: Comparison of phytoplankton presence (✓) during different seasons at the RA and TN at Gulf of Mannar during year 2014 -2015

Species	Summer 2014		Monsoon 2014		Winter 14 – 2015	
	RA	TN	RA	TN	RA	TN
Bacillariophyceae						
Actinoptychus splendens (Shadbolt)	✓		✓		✓	
Actinoptychus undulatus (J.W.Bailey)	✓	✓		✓	✓	
Amphora lineata Gregory			✓			✓
Auliscus caelatus Bailey	✓	✓	✓	✓	✓	
Auliscus sculptus (W.Smith) Brightwell	✓	✓	✓	✓		✓
Bacteriastrum varians Lauder	✓	✓	✓	✓	✓	✓
Biddulphia pulchella S.F.Gray	✓	✓	✓		✓	
Chaetoceros affinis Lauder	✓			✓		✓
Coscinodiscus asteromphalus Ehrenberg	✓	✓	✓		✓	
Coscinodiscus gigas Ehr		✓		✓		✓
Cyclotella meneghiniana Kützing	✓		✓		✓	
Diploneis bombus (Ehrenberg) Ehrenberg	✓		✓		✓	
Diploneis ovalis (Halse)Cleve	✓			✓		✓
Gyrosigma balticum (Ehrenberg)		✓	✓	✓	✓	
Mastogloia lanceolata Thwaites ex W.Smith	✓				✓	
Navicula granulata Ehrenberg	✓		✓			

Navicula lyra Ehrenberg	✓	✓		✓	✓	
Nitzschia plana W.Smith			✓		✓	✓
Paralia sulcata (Ehrenberg) Cleve	✓	✓	✓	✓	✓	
Pinnularia acrosphaeria W.Smith	✓	✓	✓	✓		✓
Pleurosigma angulatum (Queckett) W.Smith	✓	✓	✓	✓	✓	✓
Rhabdonema minutum Kutzing	✓	✓	✓		✓	
Rhizosolenia styliformis T.Brightwell	✓			✓		✓
Surirella fastuosa (Ehrenberg)	✓	✓	✓		✓	
Surirella nervatus (Grunw)		✓		✓		✓
Thalassionema nitzschioides (Grunow)	✓		✓		✓	
Thalassiosira excentrica (Ehrenberg) Cleve	✓		✓		✓	
Triceratium dubium Brightwell	✓	✓		✓		✓
Triceratium favus Ehrenberg		✓		✓		
Triceratium Robertianum Grey	✓				✓	
Cyanophyceae						
Chroococcus sp.	✓	✓		✓	✓	
Gloeocapsa polydermatica			✓		✓	✓
Lyngbya burgertii	✓	✓	✓	✓	✓	
Lyngbya sp.	✓	✓	✓	✓		✓
Microcoleus acculismus	✓	✓	✓	✓	✓	✓
Phormidium foveolarum	✓	✓	✓		✓	
Phormidium fragile	✓			✓		✓
Phormidium tenue	✓	✓	✓		✓	
Phormidium valderianum		✓		✓		✓
Phormidium sp.	✓		✓		✓	
Phormidium mole	✓		✓		✓	
Phormidium uncinatum	✓	✓		✓		✓
Synechococcus elongatus		✓	✓	✓	✓	
Spirulina subsalsa		✓		✓		✓
Synechocystis aquatilis	✓	✓	✓		✓	
Dinophyceae						
Ceratium lineatum			✓		✓	✓
Ceratium massiliense	✓	✓		✓	✓	✓

Chlorophyceae						
Cosmarium subtumidium	✓	✓	✓	✓	✓	✓
Pediastrum boryanum	✓		✓		✓	✓
Pediastrum simplex	✓			✓		✓
Pediastrum tetras	✓	✓	✓		✓	
Scenedesmus armatus		✓		✓		✓
Scenedesmus bijugatus	✓		✓		✓	

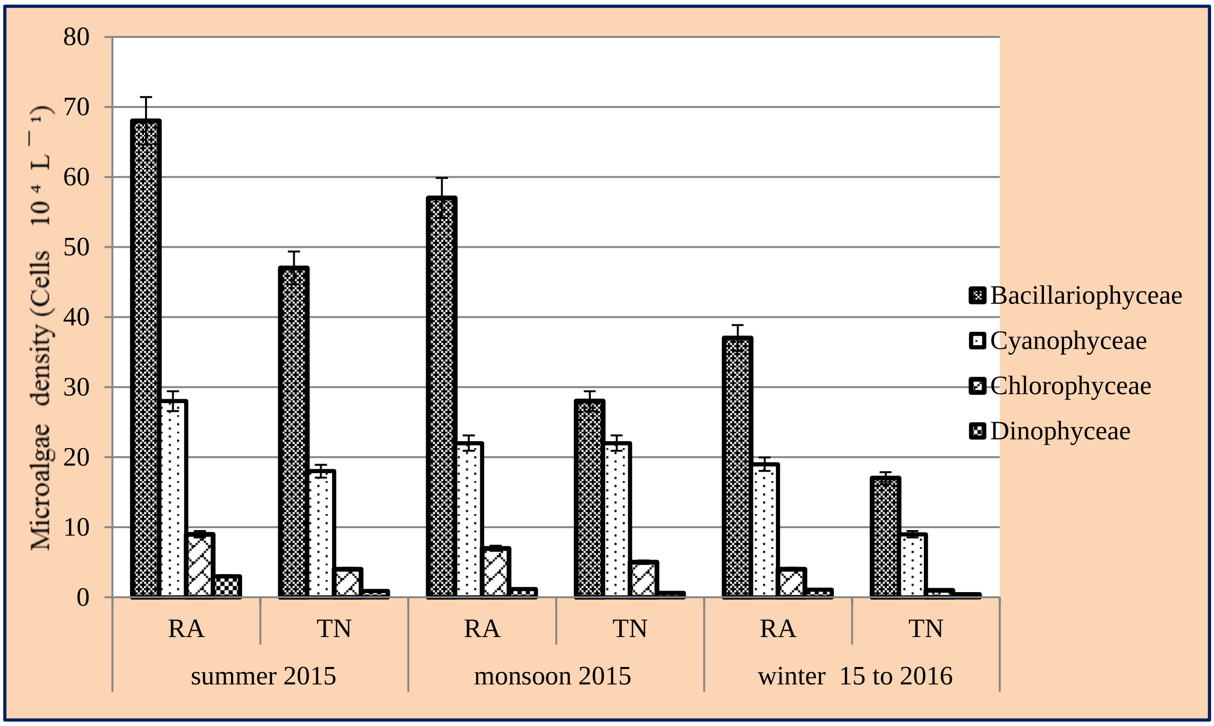

Figure 2: Seasonal variation of microalgae density observed at RA and TN during year 2014 to 2015

DISCUSSION

Diatoms are ecologically important and they are used for monitoring environmental conditions of waters. Diatoms are the dominant group in the present study and it is supported by the work of [13, 14, 20, and 21]. Diatoms are followed by dinoflagellates and blue green algae as dominant group. Similar observation were made [32] from the Palk Bay [33] from the Gopalpur [34, 35] from the Pitchavaram mangroves, [36] from the Coromandel Coast. [37] From the Pichavaram mangrove. Dominance of dinoflagellates and cyanophytes in Central Arabian Sea and Bay of Bengal [6, 8, 22]. *Amphora lineata* were recorded from the RA and TN site only during winter season. [10] Observed that *Amphora sp.* distribution during winter in Belgian coastal zone. *Cyclotella meneghiniana* was recorded only in RA site during all seasons but absent in TN site, which evident that the *C.*

meneghiniana and Scenedesmus bijugatus are the low pollution tolerant species replaced by *Pleurosigma angulatum, Bacteriastrum varians, Microcoleus acculismus and Cosmarium subtumidium, Actinoptychus splendens, Diploneis bombus, Mastogloia lanceolata, Navicula granulata, Coscinodiscus gigas, Thalassionema nitzschioide* and *Triceratium Robertianum* were reported only from RA site but their absence reported in the TN site which mainly affected by thermal power stations and other industrial pollution. This evident that diatoms are the most important primary producers of both marine and freshwater environments and regulates the ocean's silicon cycle is considerable [19, 25]. Diatoms have also been used as valuable indicators in historical assessments of water quality [16, 17, and 23]. *Triceratium dubium* is indicator for coastal wetlands [18, 24]. *T. dubium* was recorded during summer in RA and TN site, but their presence recorded during winter and monsoon seasons. The species is tolerant to thermal pollution, during monsoon and winter season the flow of water reduce the thermal pollution in RA site, hence their absence in RA site. But the TN site polluted by the thermal power plants, hence their presence indicate that the area affected by the thermal pollution.

4. CONCLUSION

From the present study the highest diversity of phytoplankton communities were observed at the RA site. The species richness increased during summer season due to positive environmental conditions and presence of nutrient abundance, but in monsoon and winter season where inflow of water is less compared with other seasons. Water quality parameter would affect the microalgae density which increased during monsoon and lesser during winter. The microalgae concentration were less during monsoon season due to the dilution factors and sudden changes of water quality parameters, which is lead to the lesser amount of photosynthetic activity by primary producers. The study reported that the microalgae played as the bio indicator of water pollution. It is concluded that TN site (Tuticorin) is most affected by pollution than the Rameswaram site (RA). Hence the comparison of the physiochemical parameters with the seasonal distribution of microalgae diversity and distribution are essential and is recommended.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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