

## Diversity and Distribution of Phytoplankton at selected sites of Jamnagar coast, Gujarat, India

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**Abstract-** Phytoplanktons are the primary producer of marine ecosystems and contribute towards the primary productivity of aquatic environment. The present study was carried out at three selected sites of Gulf of Kachchh (GoK) viz; Pirotan, Sachana and Roziport. During the study, a total of 106 species of phytoplankton were recorded, of which the highest species diversity was found at Rozi followed by Pirotan and Sachana. The maximum number of species diversity was contributed by the class Bacillariophyceae with 81.5 percentage, 79 percentage and 83 percentage at Pirotan, Rozi and Sachana, respectively. Rozi port reported the highest number of harmful phytoplankton i.e. some members of Bacillariophyceae and Dinophyceae. The highest number of species was recorded at Rozi port (75 sp.) followed by Pirotan (54 sp.) and Sachana (46 sp.). The varied environmental conditions prevailing at three study sites may cause variation in species composition at these sites.

**Keywords-** Coral reef, Island, Mangrove, Phytoplankton, Port, Sewage, ship breaking yard

### I. INTRODUCTION

Phytoplanktons are group of photosynthetic microalgae that serve as a primary producer & important component in the food web. They use solar radiation and CO<sub>2</sub>, nutrients and trace element to process their food. Phytoplankton imparts 20-25 % of the world's total net primary production [1]. They initiate the marine food chain, by serving as food to primary consumers. Therefore, phytoplanktons are of great significance. Taxonomically, phytoplanktons taxonomic composition globally includes about 4000–5000 species [2, 3] Life cycle of phytoplankton is mainly affected by abiotic factors such as salinity, light, temperature, turbulence, water quality & other parameter. Phytoplanktons species are indicators of environmental changes, and long-term time-series are effective tools to evaluate and understand these changes [4].

### II. MATERIALS AND METHODS

#### **Study area:**

Gulf of Kachchh (GoK) is an extension of Arabian Sea & located in 22° 15' N to 23° 40' N latitude and 68° 20' to 70° 40' E longitude. It has an area of 7350 sq.km and depth varies from less than 10 meters at head and 60 meters at outer region [5]. The average depth in Gulf of Kachchh is of 30 meters. It has higher evaporation rate as compared to precipitation rate [6] and receives inflow of water only in monsoon. Some portions of the coastal area from Okha to Jodiya have been declared as Marine National park & Sanctuary. These areas are rich in wide range of habitats, including Coral reef, Mangroves, Mudflats, salt pans that support biodiversity of plants and animals. The area also supports livelihood of local people. It has fish landing centers, fisheries processing units, many small and medium ports, wood processing industry, salt pans, Brine industry, and Special Economic Zones.



**Fig: 1** Map showing study area of the map and selected sites of Gulf of Kachchh (Google images)

**Site description:** The present study was carried out at three sites of GoK viz; Pirotan island, Sachana & Rozi port. The site location and GPS points of the same are shown in Figure 1 and Table 1 respectively.

**Table: 1 Description of selected sites for sample Collection.**

SN.	Site	Latitude (N)	Longitude ( E)	Description
1	Pirotan (PI)	22° 35' 13.3"	69° 56' 21.6"	Mangrove and Coral reef
2	Sachana (SA)	22°34'18.83"	70 °10'55.24"	Ship breaking yard
3.	Rozi (RO)	20°43'16.99"	70°2'42.31"	Port

**Pirotan:** Pirotan is an island located in Gulf of Kachchh. It comes under Marine National Park, Jamnagar, Gujarat state, India. It is located at a distance of 12 nautical miles from Bedi port. It comprises of mangroves, coral reefs and low-tide beaches, and has an area of 3 square kilometers. Pirotan has rich marine biodiversity [7].

**Sachana:** Sachana is situated 25 km away from Jamnagar. The village has important fish landing center. Sachana coastal area used to have ship breaking yard. At the time of ship wreck, engine oil, other garbage and non biodegradables material released from the ships used to spread in other area. Coastal area from Khijadiya to Sachana is rich in mangrove.

**Rozi port:** Rozi port is an intermediate port & falls under Marine sanctuary. The ships are loaded and unloaded at Roziport. That may increase the chance of spreading of pollutants. Inflow of Nagmati and Rangmati rivers brings the flow of sewage of Jamnagar city at this site. Therefore, the site was chosen for investigation.

**Methodology:** The phytoplankton samples were collected during the year 2011 to 2014 on monthly basis. The samples were collected by grab sampling. During sampling, five liters of water sample was collected in bucket and this water was passed through 20 µmesh size sieve. The samples were collected in 250 ml plastic bottle and preserved in 1 ml 4 % formaldehyde solution. For microscopic observation, 0.1 ml of preserved sample was taken and analyzed by Lackey's drop method. The samples were observed under light microscope (made Gippon). The phytoplanktons were identified using the book on Identifying Marine phytoplankton [8].

### III. RESULTS AND DISCUSSION

A total of 106 species have been reported from study area. Fig. 2 illustrates the number of families, genera, and species recorded at studied sites. The checklist of phytoplankton species is mentioned in Table 2. The highest number of species was recorded from Rozi port followed by Pirotan and Sachana.

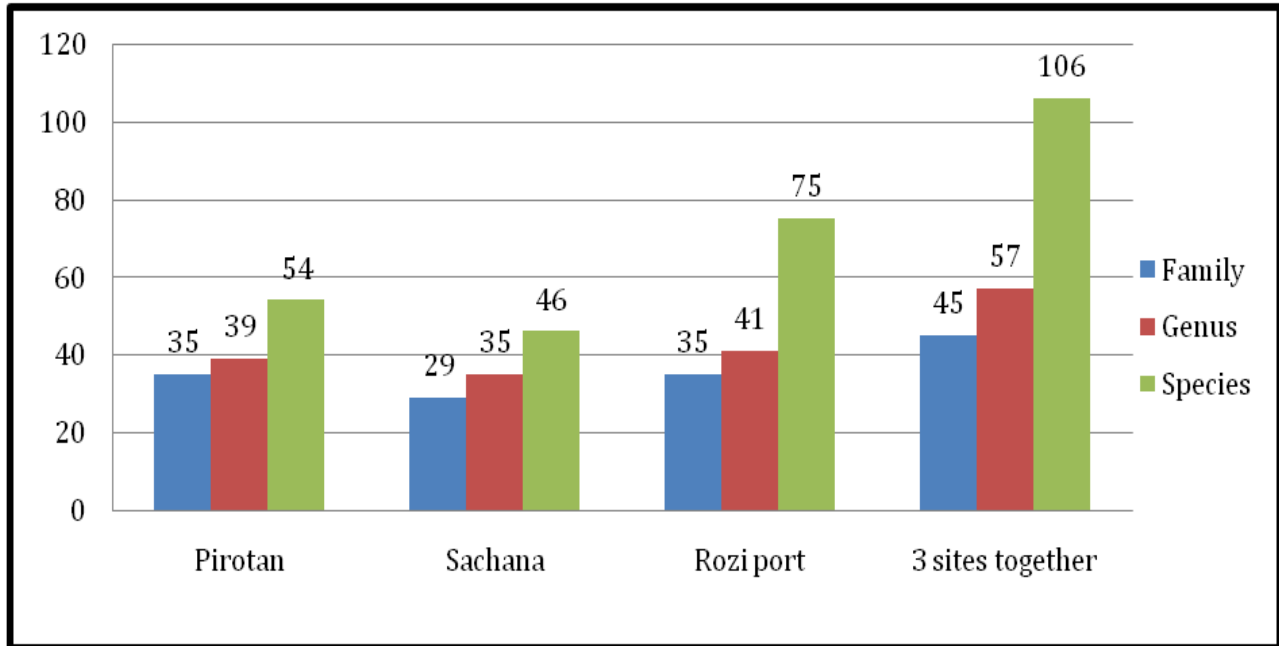
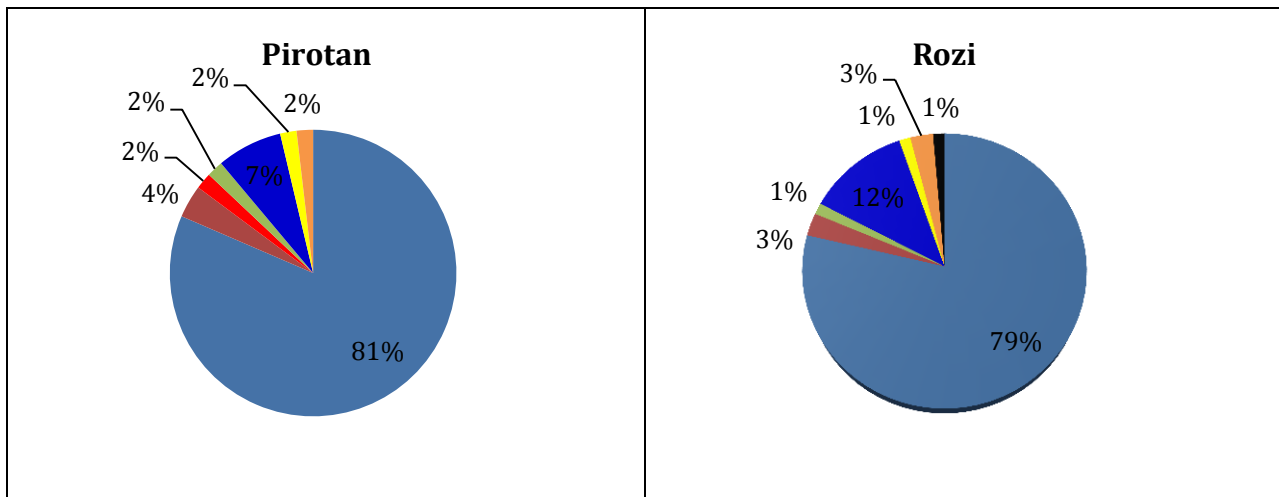
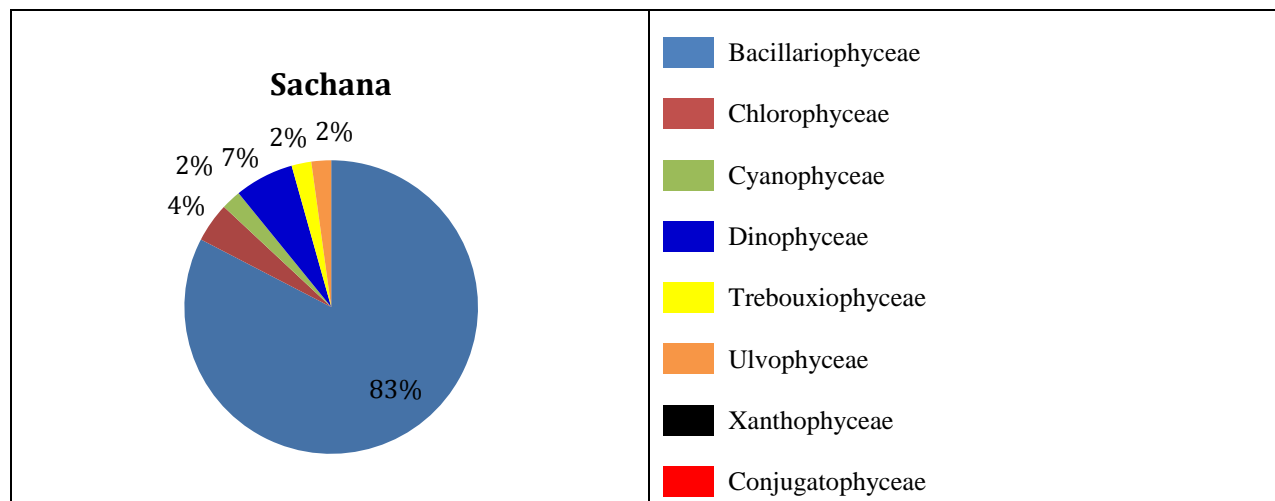


Fig : 2 Site wise number of family, Genus and Species.

The contribution of different classes to phytoplankton population at three sites is depicted in Fig. 3. The study has recorded presence of 8 classes viz; Bacillariophyceae, Chlorophyceae, Cyanophyceae, Dinophyceae, Conjugatophyceae, Trebouxiophyceae, Ulvophyceae, and Xanthophyceae. The class Bacillariophyceae had highest % distribution at all sites followed by Dinophyceae. Similar kinds of results were obtained for Orissa coast [9]. Several other researchers also found dominance of Bacillariophyceae (i.e. Diatoms) followed by Dinoflagellates [4, 10, 11]. There was variation in distribution of species at three sites From the present study it was observed that, 24 species of phytoplanktons were common at all the sites which includes *Achnanthis minutissimum*, *Ceratium gibberum* sp., *Ceratium lineatum* sp., *Chaetoceros decipiens* sp., *Coscinodiscus robustus* sp., *Diploneis crabro*, *Eucampia zodiacus* sp., *Fragilaria capucina*, *Gyrosigma acuminatum*, *Minidiscus trioculatus*, *Navicula lanceolata*, *Nitzschia palea*, *Nitzschia radicola*, *Nitzschia tryblionella*, *Odontella mobiliensis*, *Pediastrum boryanum*, *Picochlorum atomus* sp., *Pinnularia microstauron*, *Pinnularia* sp., *Protoperidinium divergens*, *Scenedesmus pulloideus*, *Tabellaria fenestrata*, *Thalassionema nitzschioides*, and *Thalassiosira punctigera*.





**Fig: 3** Class wise percentage contribution of phytoplankton at three selected sites.

The overall class-wise distribution of species at three sites showed highest percentage of Bacillariophyceae (81.5%) followed by Dinophyceae (4%), Chlorophyceae (3.7%), Conjugatophyceae (1.9%), Cyanophyceae, Trebouxiophyceae (1.9%), and Ulvophyceae (1.9%).

**Pirotan:** The site Pirotan showed dominance of two genera, namely, *Nitzschia* sp. and *Rhizosolenia* representing seven and three species of phytoplanktons, respectively. The class xanthophyceae was absent from Pirotan. There are about seventeen species that are exclusively present at this site; these species may be sensitive to change in abiotic and biotic factors and include *Actinocyclus octonarius*, *Asteromphalus* sp., *Cocconeis oblonga*, *Gomphonema gracile*, *Manguinea regida*, *Nitzschia recta*, *Nitzschia linearis*, *Pleurosigma falcatum*, *Protoperidinium pellucidum*, *Rhizoclonium tortuosum*, *Rhizosolenia acicularis*, *Rhizosolenia robusta*, *Spirogyra hyalina*, *Surirella caproni*, *Surirella patella*, *Synedra ulna*, and *Thalassiosira oestrupii*.

**Rozi:** It is located on Jamnagarcoast of the GoK. The Rangmati and Nagmati rivers discharge sewage and industrial effluents in this area. Similar to other two sites, this site also showed highest % distribution of Bacillariophyceae (79%) followed by Dinophyceae (12%), Chlorophyceae (3%), Cyanophyceae(1%), Trebouxiophyceae (1%), Ulvophyceae (3%), Xanthophyceae (1%). The genus *Nitzschia* was found to be dominant (9 species) followed by *Pleurosigma* and *Pseudo-nitzschia* (4 species each), whereas *Odontella Prorocentrum* and *Thalassiosira* were represented by three species of each genus. Other species are mentioned in checklist (Table 2). Among three selected sites, the highest number of Dinophyceae (12%) species was reported from this site. Moreover, the site showed presence of certain species of diatoms i.e. *Pseudo-nitzschia seriata*, *Pseudo-nitzschia turgidula* and *Pseudo-nitzschiamultiseris* and some genera of dinoflagellates namely *Gymnodinium* sp., *Protoperidinium* sp. and *Prorocentrum* sp. which are known to be toxic in nature and may negatively impact the organisms present in that ecosystem.

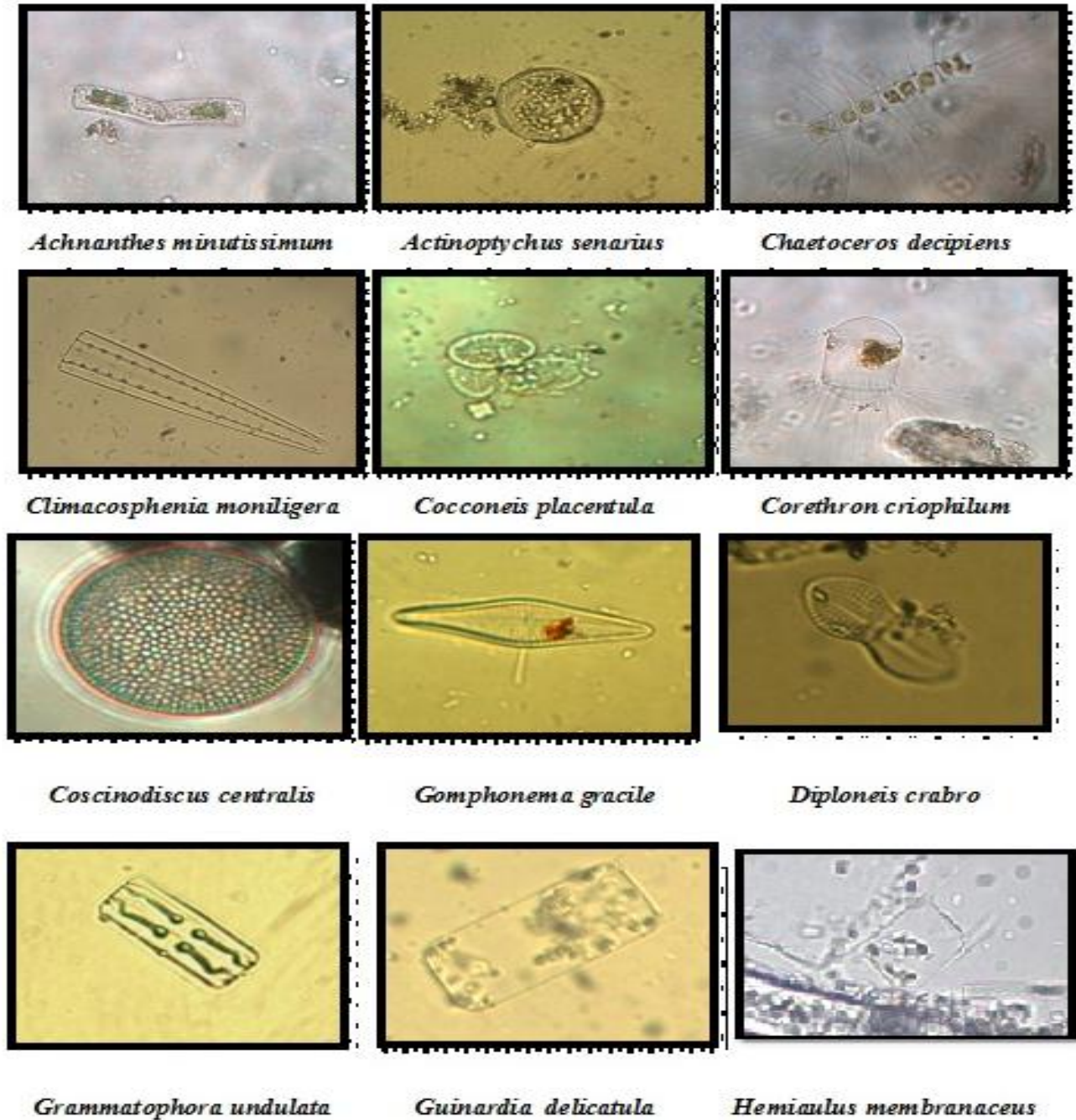
**Sachana:** This site is mainly used as fish landing centre. This study reported occurrence of 83% of Bacillariophyceae followed by Dinophyceae (7%) and Chlorophyceae (4%), whereas the Cyanophyceae, Trebouxiophyceae and Ulvophyceae each contributed 2% respectively to the total population of Phytoplankton at this site. This site showed presence of four species of *Nitzschia* and three species of *Coscinodiscus*. Other species of phytoplankton are mentioned in Table 2. There are five species of phytoplankton namely *Corethron pennatum*, *Nitzschia acicularis*, *Pseudo-nitzschia multiseris*, *Rhizoclonium* sp., *Rhizosolenia imbricata* which were recorded from Rozi and Sachana only. Both these sites receive pollutant by anthropogenic means. Therefore, these species may be treated as pollution tolerant species.

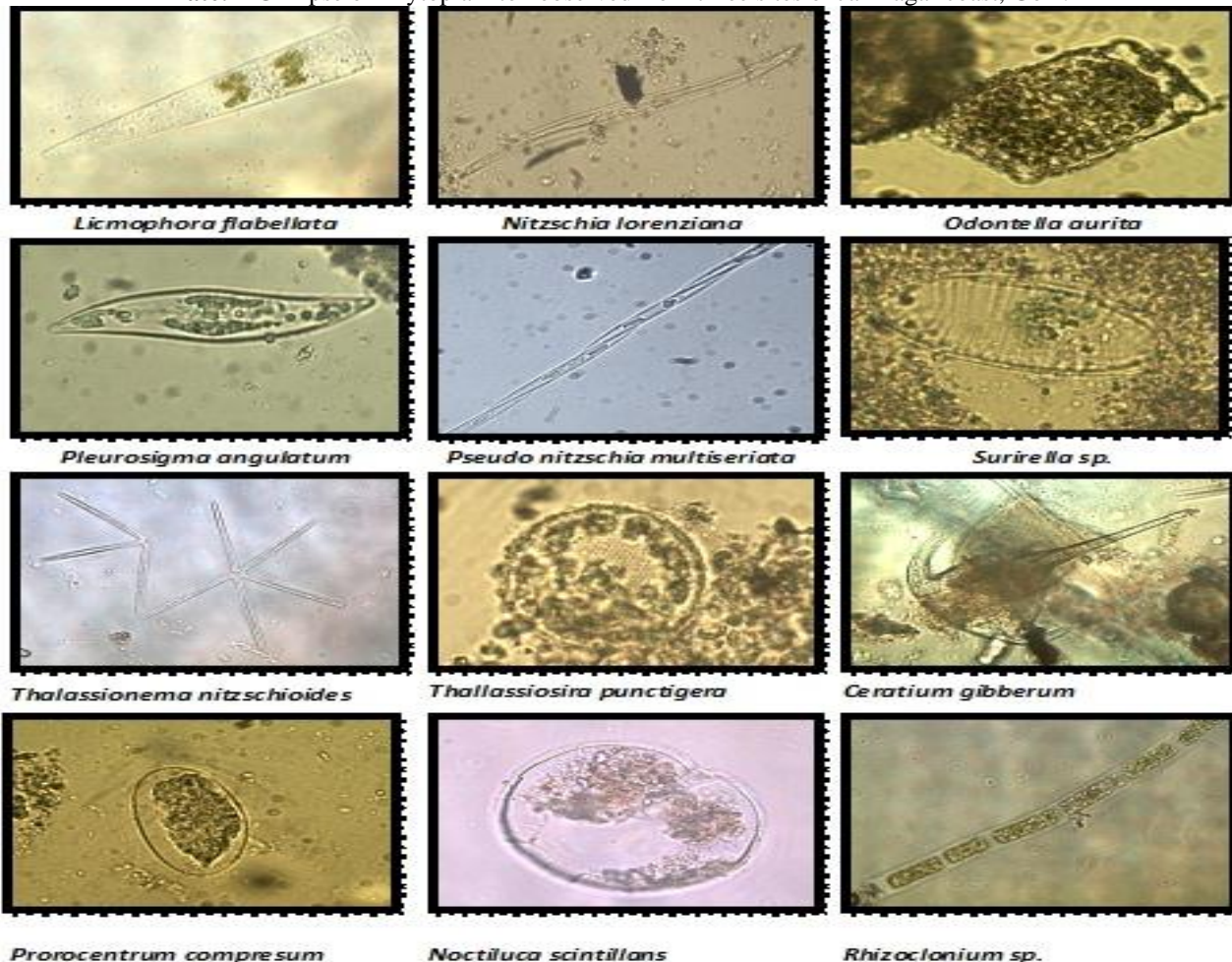
Overall, there are 24 species that are common at the three studied sites which might be due to the ability of these phytoplankton to acclimatize all types of environment [12]. The study also revealed presence of certain species that forms "Harmful Algal Blooms (HABs)". Additionally, five species of *Pseudo-nitzschia* were observed from Sachana and Rozi which are known to produce and release toxin (Domoic acid) [13]. Some diatoms belonging to genus *Chaetoceros* are responsible for damaging fish gills and cause inflammatory responses, making them susceptible to infection. Again certain species of Dinoflagellates and *Rhizosolenia imbricata* causes red tide [14] which is also reported in the present study.

IV. CONCLUSION

The present study revealed diversity and distribution of phytoplankton variation among three sites of southern GoK. The variation in species distribution may be due to environmental conditions prevailing there. Harmful diatom species belonging to genus *Pseudo-nitzschia* were not encountered from Pirotan. Moreover, only three species of Dinophyceae were found to be present at this site; hence this site can be considered as non-polluted. On the other hand, Rozi has the highest number of harmful phytoplankton species and therefore, regular monitoring of water samples is required in this area.

Plate: 1 Glimpse of Phytoplankton observed from three sites of Jamnagar coast, GoK.



**Plate: 2** Glimpse of Phytoplankton observed from three sites of Jamnagar coast, GoK.

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