Journal of Global Biosciences
ISSN 2320-1355
Volume 7, Number 9, 2018, pp. 5685-5694
Website: www.mutagens.co.in

Research Paper

PHYTOPLNKTON DIVERSITY AND PHYSICO – CHEMICAL ANALYSIS OF WATER IN COASTAL TALUKAS OF GULF OF CAMBAY, GUJARAT

Dhara Omprakash Bhavsar and Himanshu A Pandya

Department of Botany,
Bioinformatics and Climate Change Impacts Management
Gujarat University,
Ahmedabad, Gujarat,
India.

Abstract

Phytoplankton is the primary producers, without them there would be no life in the seas and oceans. Phytoplankton forms the basis for the marine food web by forming the vital source of energy by the products of their photosynthesis. The productivity of an aquatic environment is directly correlated with the density of phytoplankton population in any aquatic system is biological wealth of water for fishes and constitutes a vital link in the food chain. Phytoplankton diversity responds rapidly to changes in the aquatic environment particularly in relation to nutrients. In present study samples were collected from five districts they are Ahmedabad, Anand, Surat, Valsad, and Bhavnagar. Water samples were analyzed for the following parameters; pH, TDS, DO, Temperature, Chlorinity, Total Hardness and Alkalinity. Overall total 19 different phytoplankton species were found during study period. The recorded genera were categorized into seven genera- Navicula, Cosinodiscus, Nitzschia, Plurosigma, Surirellia, Cylindrotheca and Prorocentrum.

Key words: Phytoplankton, Diversity, Gulf of Cambay, Gujarat, Physico-chemical.

INTRODUCTION

Tropical wetlands have played a significant role in large number of ecological niches and harbor and considerable percentage of world's biological diversity for humankind in all continents. Wetlands are among the most productive ecosystems in the world comparable to rainforests and coral reefs. Most of the floating plants in the Oceans are the unicellular microscopic algae which are called phytoplankton. The productivity of an aquatic environment is directly correlated with the density of phytoplankton population in any aquatic system is biological wealth of water for fishes and constitutes a vital link in the food chain. They are primary producer of the food chain and places in lowest tropic level in the food chain of freshwater ecosystem.

The pelagic algal communities make important contribution to the smooth functioning of mangrove ecosystem. The fertility and healthiness of mangrove environment is reflected through productivity of the phytoplankton as primary producers. The quality and quantity of phytoplankton is good indicator of water quality. The productivity of an aquatic environment is directly correlated with the density of phytoplankton population in any aquatic system is biological wealth of water for fishes and constitutes a vital link in the food chain [11]. The maintenance of a healthy aquatic ecosystem depends on the abiotic properties of water and the biological diversity of the ecosystem. Phytoplanktons are currently responsible ~50% of global primary production.

Climate change over the next century is expected to modify ocean ice cover temperature, precipitation and circulation, altering the environmental conditions that influence phytoplankton standing stock and primary production. Ocean acidification, ozone depletion and associated changes in UV-B in the upper water column, coastal eutrophication and other forms of pollution along with fishing pressure superimpose additional stresses on marine ecosystems. In aggregate these stressors will modify phytoplankton community structure and have cascading consequences on marine food web dynamics and elemental cycling [1, 2].To improve predictions of marine ecosystem in responses to environmental and climate change, phytoplankton physiologists and ecologists need to determine how to quantify and parameterize the physiological responses of phytoplankton that will in turn affect marine food webs and the environment [10].

Phytoplanktons not only serve as food for aquatic animals but also play an important role in maintaining the biological production. Phytoplankton diversity responds rapidly to changes in the aquatic environment particularly in relation to nutrients.

MATERIALS AND METHODS

Study area

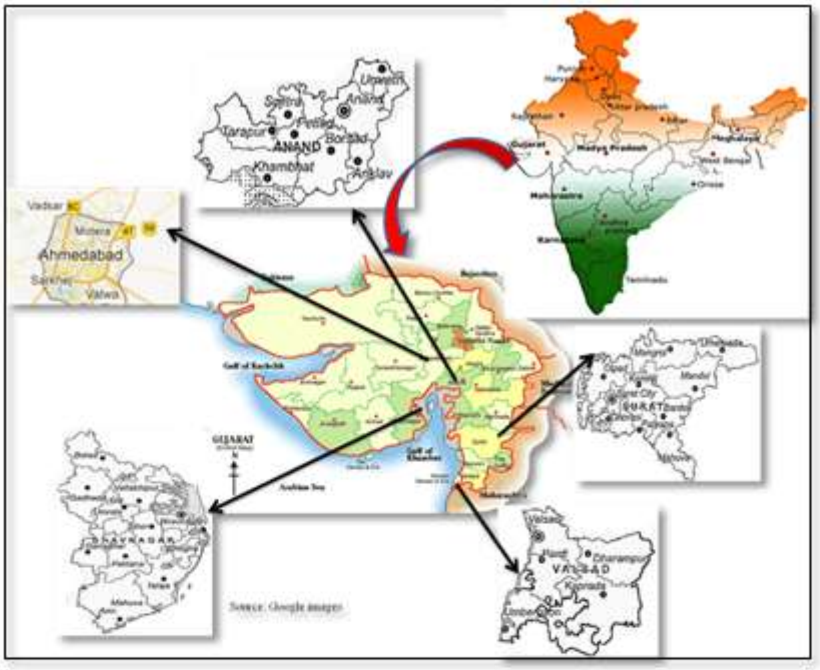

Figure 1 Study area, Gulf of Cambay

The Gulf of Khambhat is a south to north penetration of the Arabian Sea on the western shelf of India between the Saurashtra peninsula and mainland Gujarat. It is located approximately between latitude 20°30' and 22°20'N and longitude 71°45' and 72°53' E. it is 70 km wide and 131 km long located between Saurashtra peninsula and the main land Gujarat.

In present study samples were collected from five districts they are Ahmedabad, Anand, Surat, Valsad, and Bhavnagar. In Ahmedabad district the coastal area passes from the Dholka and Dandhuka talukas. Sampling was done from the coastal area which passes from the Bhangadh village. In Anand district Wadgam, Tadtlav, Dhuvaran; these three talukas are included for sampling. In Surat district the sampling was done from the Dumas coast, Dumas setu site, Tapi-Dumas estuary, Mangrol coast. In Valsad district study area covers the coastal area of Nargol, Umargam, Umarsadi estuary, Machchiwad, etc villages. While in Bhavnagar district the sampling was done form the Hathab and Gopnath areas.

Sample strategies and procedure

Samples were collected with plankton from the sea surface and stored in the plastic bottles. After collecting the samples the plastic bottles were placed into the ice chest followed by scientific preservation in Lugol's solution. From each site two samples were collected one for phytoplankton study and other for water analysis. All the samples were stored in the refrigerator for its better preservation.

Water samples were analyzed for the following parameters; they are pH, TDS, DO, Temperature, Chlorinity, Total Hardness and Alkalinity. Amongst these seven parameters four parameters PH, TDS, DO, Temperature were measured at the site only with the help of a kit. Water samples were also analyzed for the nutrient parameter like Iron, Potassium, Manganese, Aluminum, Sulfite, Sulfide etc. Alkalinity and other nutrient parameters were examined with the help of Lovibond Tintometer (Maxi direct). This Tintometer is working on the principle of the spectrophotometer**.** phytoplankton diversity study was carries out by Lawrence and Mayo, LM-52-1804 compound microscope and special type of slide which is called Sedgwick Rafter is used for the same**.**

Figure 2 A. Tintometer, B. Soil and Water Analysis kit, C. Lawrence and Mayo Compound microscope

The hydro chemical parameters have been shown in the Figure 3. Water bodies undergo temperature variations that occur seasonally. The rate of chemical and biological processes in surface water, especially oxygen levels, photosynthesis and algal production, are strongly influenced by temperature. The surface water temperature varies between 29 to 35°C. The pH of water affects the solubility of many toxic and nutritive chemicals; therefore, the availability of these substances to aquatic organisms is affected. The pH of the surface water was alkaline and fluctuated between 7.5 and 8.6. It is good that the pH was within limits. The lowest pH was noticed in sample 24 and sample 22 they are 4.3 and 6.3 respectively. The value of TDS ranged from 6879 to 8407 mg/l. TDS shows high value because sampling was done during the summer season. Low concentrations of dissolved substances have no significant influence on the water quality but high concentrations affect the water quality. The DO have been reported ranged between 2.45 to 3.45. Dissolved Oxygen is generated by the photosynthetic activity and aeration rate. The distribution of DO in aquatic ecosystem is maintained by a balance between input from the atmosphere, rainfall, photosynthesis and losses by the chemical and biotic oxidations. The alkalinity of water depends on the carbonate and bicarbonate ions only and in very minor amount on magnesium, sodium, and potassium. In present study alkalinity ranges between 58 to 180 mg/l. Chlorinity of the water samples vary between 227 mg/l to 1140 mg/l. The lowest chlorinity was observed in sample 19 and highest in sample 5.The presence of chlorides in natural waters can mainly be attributed to dissolution of salt deposits in the form of ions (Cl^-). High concentrations may indicate pollution by sewage or some industrial wastes. It is the major form of inorganic anions in water for aquatic life. Total hardness varied from 1236 mg/l to 2840 mg/l. Highest total hardness was examined in sample 15 and lowest in sample 27.

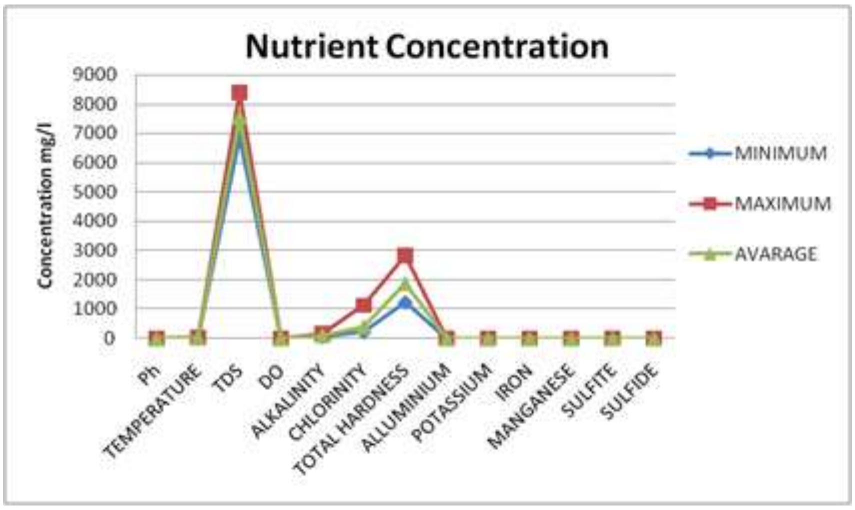

Figure 3 Minimum and Maximum Nutrient Concentrations in mg/l

Nutrients are essential for the growth of phytoplankton, algae and other plants. Aquatic life is dependent upon these nutrients, which usually occur in low levels in surface water. Aluminum should not be present in the marine water because it is very harm full for all living organisms. In present study it is not found in most of the water samples, but it is found in four samples in very low amount. It ranged between 0.02 to 0.36 mg/l. 0.02 mg/l aluminum was observed in sample 27 and 0.36 mg/l was observed in sample 32. Potassium was found in high amount which ranged between 4.9 mg/l and 12 mg/l. Potassium is found in low concentrations in natural waters, as rocks, which contain potassium is relatively resistant to weather conditions. It is usually found in ionic form and the salts are highly soluble. Though found in small quantities it plays a vital role in metabolism of water environment. The lowest amount of iron is 0.02 mg/l which is found in most of the samples, while the highest amount of iron is 0.05 mg/l which is found in only sample 30. The presence of iron in natural water can be characteristic to the dissolution of rocks and minerals, acid mine drainage, sewage or engineering industries. The manganese was examined in high amount. It stuck between 0.53 mg/l to 4 mg/l. manganese plays an important role in the growth of phytoplankton when the iron is low in the water. Sulfite and Sulfide are found under range in all the samples which is ranged between 0.1 mg/l to 0.2 mg/l.

pH of the surface sea water fluctuated between 7.5 and 8.6 but in sample 24 and sample 22 pH was noticed 4.3 and 6.3 respectively this shows that here the coastal water receives fresh water supply. It is well known that the temperature and salinity affect the dissolution of oxygen.

The solubility of oxygen in water increased by decreasing the temperature; it means that solubility of oxygen in water is affected inversely by the rise in temperature [1, 4, 11].

In present study when the temperature is 35°C DO was noticed only 2.45 mg/l. Scientist studies stated that a number of physico – chemical and biological factors performing simultaneously must be taken into consideration in understanding the diversity of plankton population [4]. The composition of phytoplankton is dependent on different abiotic factors either directly or indirectly [9]. Nutrients are considered as one of the most important parameter in the estuarine environment influencing growth, reproduction and metabolic activities of living organisms. Distribution of nutrients is mainly based on the season, tidal conditions and freshwater flow from land source. The diatom may be growing well in the water in which nutrients present in low amount, because in such water the grazing pressure of zooplankton is low [14, 18]. The study shows that coastal and oceanic diatoms and concluded that it require more manganese (Mn) to grow in iron (Fe) deficient seawater than in Fe-sufficient seawater [8].

Phytoplankton diversity

Phytoplankton was identified by using manuals and monographs for phytoplankton identification. Identification was done till the genus level. Total nineteen different species of phytoplankton was found. Most of them are diatoms. There are six different species of genus Navicula, three different species of genus cosinodiscus, three different species of genus Nitzschia, and two species of genus Plurosigma, two different species of genus Surirellia, and one species of cylindrotheca, one species of Prorocentrum was found. Cosinodiscus, Cylindrotheca, Navicula, Nitzschia, Plurosigma these all genus belong to the same division Bacillariophyta, while Cylindrotheca closterium falls in the division Chrysophyta and genus Prorocentrum goes to the division Dinophyta.

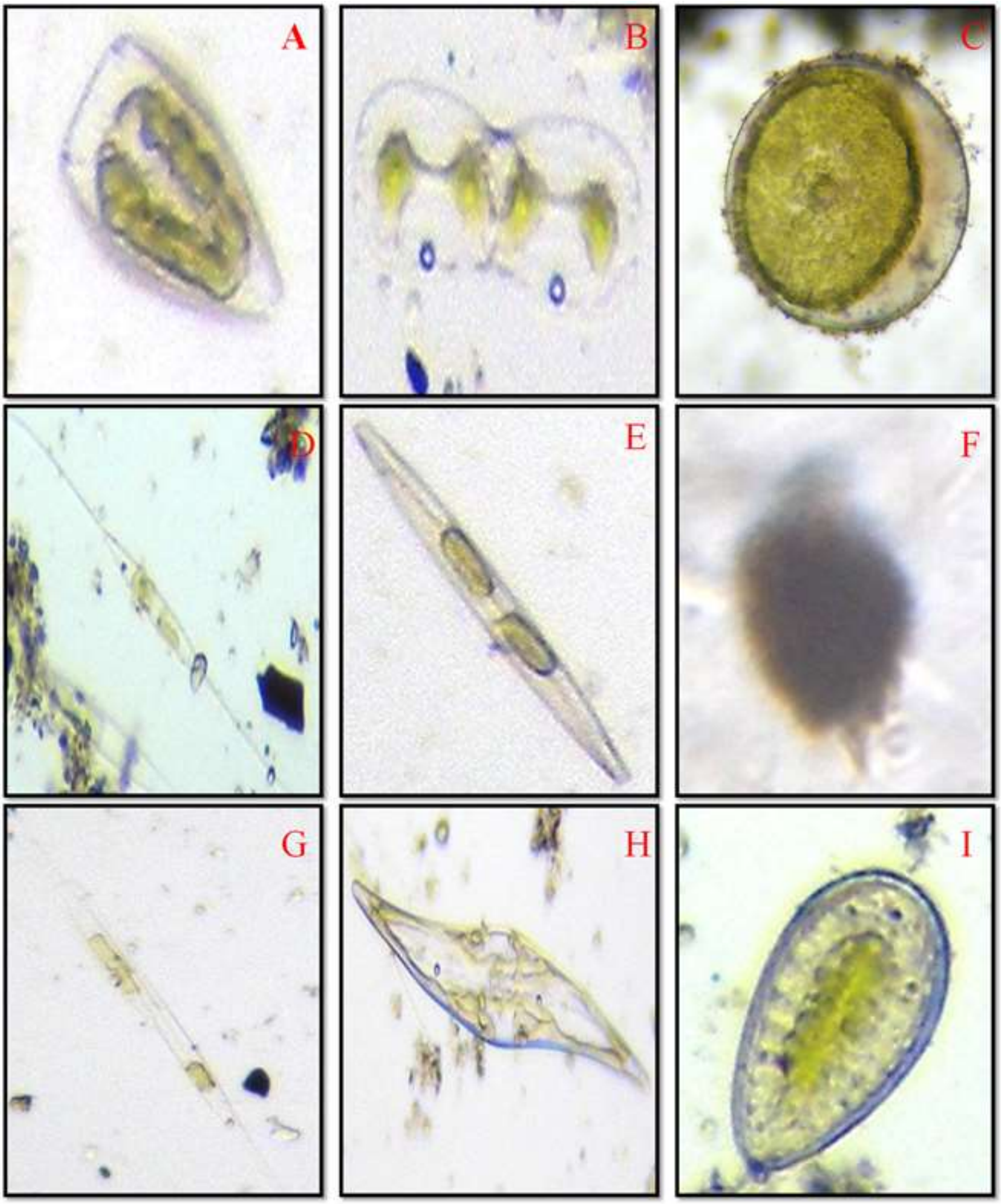

Figure 4 Phytoplankton Genus A and C Cosinodiscus, B and E Navicula, D Clostorium, F Prorocentrum , G Nitzschia, H Plurosigma, I Surirellia.

CONCLUSION

According to the results assumption can be made that the water of the coastal region of gulf of khambhat is neither polluted nor nutrient sufficient. The most important nutrient for phytoplankton is iron which is present in very less amount. The other parameters like high temperature, less dissolved oxygen also affect the growth of phytoplankton. Overall total 19 different phytoplankton species were found during study period. Coastal area of Bhavnagar is having highest phytoplankton diversity while coastal area of Surat and Valsad having lowest phytoplankton diversity during the study period. Ahmedabad and Anand coast comprise average phytoplankton diversity.

ACKNOWLEDGEMENTS

Authors are thankful to Dr Gunjal Motwani, Scientist, ISRO, Ahmedabad for the facilitate in identification of phytoplankton and Ms Avni Rao for laboratory support and help to complete this project.

REFERENCES

1. A.Saravanakumar, M. Rajkumar, G.A Thivakaran and J sesh Serebiah (2008) Abundance and seasonal variation of phytoplankton in the creek waters of western mangrove of Kachchh-*Gujarat. Journal of Environmental Biology*, 29(2), pp 271-274.
2. Anonymous: Description of commonly considered water quality constituents.
3. Anonymous (2012) Global last Monograph series No 7, Phytoplankton Identification catalogue.
4. B. Moss (1988) Ecology of Freshwaters, Man and Medium, second edition, Blackwell Scientific Publications, London, p 417
5. B. P. Muduli, C. R. Panda, (2010) physic chemical properties of water collected from dharma estuary, *International Journal of Environmental Sciences*, vol. (3), pp 334-342
6. D. Nilsun, U.Kirkagac Mine (2005) Plankton composition and water quality in a pond of spring origin in Turkey. – *Limnology* 6, pp 189–194.
7. ENVIS Technical Report (2012) Water, Soli, and sediment characterization, Sharavathi River Basin, Western Ghats.
8. G. Rajashree and R.C Panigrphy (1996) Ecology of phytoplankton in coastal water off Gopalpur, east coast of India, *Ind. J. Mar. Sci*., 2, pp 13-18.

9. J.I Nirmal Kumar (2011) phytoplankton composition in relation to hydrochemiacl properties of tropical community wetland, kanewal, Gujarat, India, *Applied Ecology and Environmental Research* 9(3) pp 279-292.
10. J. M. Jaiswar, A. V. Mandalia, S. M. Narvekar, S. H. Karangutkar (2011) Nutrient fluxes and adaptation to environmental dynamics by phytoplankton in the Gulf of Khambhat, *Int. J. Curr. Res*., vol.3, pp 5-13.
11. K. Vijaykumar and S. Majagi (2008) Ecology and abundance of zooplankton in Karanja reservoir, Environmental Monitoring and Assessment 152(1-4), pp 451-8
12. M. Jiyalal Ram, R. Vijayalakshm Nair and B.N.Desai (1990) Distribution of phytoplankton of Mithapur (Gujarat), J. of the Indian Fisheries Association Vol. 19, pp. 49-57.
13. N.K.Sharma and Shaily Bhardwaj (2011) An Assessment of Seasonal Variation in Phytoplankton Community of Mahi River (India), Geneconserve 10(40), pp 154-164
14. N. P. Vengadesh, M. Rajkumar, P. Perumal and K Thillai Rajasekar (2009) seasonal variation of plankton diversity in the kaduviyar estuary, Nagapatinam, southeast coast of India, *Journal of environmental Biology*, *J Environ*, 30(6), pp 1035-46.
15. P. Graham and M. Price Neil (2004) A role for manganese in superoxide dismutase and growth of iron-deficient diatoms, *Limnol Oceanography*, 49(5), pp 1774-1783.
16. S.S Kadam and L.R Tiwari (2011) Ecological study of phytoplankton from dahanu creek west *coast of India, Indian Journal of Geo-Marine Sciences*, vol. 40(4), pp 593-597.
17. T. Bardarudeen, K.T Damodaran, K Sajan and D Padmalal (1996) Texture and geochemistry of sediments of a tropical mangrove ecosystem, south coast of India, Environ*. Geol*., 27, pp 164-169.
18. V. Kensa Mary (2011) inter-relationship between physic-chemical parameters and phytoplankton diversity of two ponds of kulasekhram area kanyakumari district, tamilnadu, *Plant science feed* 2011-1 (8), pp 147-154.

19. Z. Kawabata, A. Magendran, S. Palanichamy, V. K. Venugopalan, and Tatsukawa (1993 Phytoplankton biomass and productivity of different size fractions in the velar estuarine system, southeast coast of India. Ind. *J. Mar. Sci*., 22, pp 294-296.