RESEARCH PAPER

Studies on Physico – Chemical Characteristics and Phytoplankton Diversity of Paravanar Estuary, Cuddalore Coast (South East Coast of India)

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ABSTRACT

The present study investigates the relationship between physico-chemical parameters and phytoplankton diversity in the Paravanar estuary, located along the Cuddalore coast of southeast India. Monthly sampling was conducted over a one-year period (September 2023 to August 2024) at two ecologically distinct sites to assess variations in water quality and phytoplankton composition. Key physico-chemical parameters, including atmospheric and surface water temperature, pH, salinity, dissolved oxygen, inorganic nutrients (nitrate, nitrite, phosphate), and reactive silicate, were analyzed using standard methodologies. The results revealed significant seasonal fluctuations in environmental variables, largely influenced by monsoonal dynamics. Temperature ranged from 24°C to 36°C, pH from 6.0 to 7.7, salinity from 11 to 26.2‰, and dissolved oxygen from 3.7 to 8.1 mg/L. Nutrient concentrations exhibited higher values during the monsoon season, attributed to increased freshwater influx and terrestrial runoff. These variations played a crucial role in shaping phytoplankton community structure. A total of 58 phytoplankton species were identified across both sites, belonging to five major classes: Bacillariophyceae, Dinophyceae, Cyanophyceae, Chlorophyceae, and Chrysophyceae. Among these, Bacillariophyceae (diatoms) dominated the assemblage, indicating favorable ecological conditions for their proliferation. Spatial differences between sites were primarily influenced by salinity gradients and freshwater input, leading to variations in species composition and abundance. The study highlights the strong interdependence between physico-chemical characteristics and phytoplankton diversity in estuarine ecosystems. The findings provide valuable baseline data for monitoring ecological health and understanding the impacts of environmental changes and anthropogenic activities on coastal water bodies. This research contributes to the sustainable management and conservation of estuarine ecosystems in the region.

KEY WORDS: Physico-chemical parameters; Phytoplankton diversity; Estuarine ecosystem; Paravanar estuary; Seasonal variation; Water quality; Nutrient dynamics; Bacillariophyceae; Coastal ecology; Monsoonal influence.

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1. INTRODUCTION

Plankton are the tiny organisms which are drifted by water currents. The word "Plankton" has been introduced by Victor Henson in 1887 which means wanderer in Greek. Phytoplankton are photosynthesizing microscopic organisms that inhabit the upper sunlit layer of almost all oceans and bodies of fresh water on earth. They are agents for "primary production," the creation of organic compounds from carbon dioxide dissolved in the water, a process that sustains the aquatic food web (Jump up and Thurman, 2007). Phytoplankton obtain energy through the process of photosynthesis and must therefore live in the well-lit surface layer sea, lake, or other body of water. Phytoplankton account for about half of all photosynthetic activity on earth Jump up *et* *al*. (2011). Their cumulative energy fixation in carbon compounds is the basis for the vast majority of oceanic and many freshwater food webs. The effects of anthropogenic warming on the global population of phytoplankton are an area of active research. Changes in the vertical stratification of the water column, the rate of temperature, dependent biological reactions, and the atmospheric supply of nutrients are expected to have important effects on future phytoplankton productivity (Jump up, 2010). Additionally, changes in the mortality of phytoplankton due to rates of zooplankton grazing may be significant. As a side note, one of the more remarkable food chains in the ocean remarkable because of the small number of links is that of phytoplankton feeding krill feeding baleen whales. Most all phytoplankton species are obligate photoautotrophs, there are some that are mixotrophic and other, non-pigmented species that are actually heterotrophic (the latter are often viewed as zooplankton). Of these, the best known are dinoflagellate genera such as *Noctiluca* and *Dinophysis*. The term phytoplankton encompasses all photoautotrophic microorganisms in aquatic food webs.

Phytoplankton serves as the base of the aquatic food web, providing an essential ecological function for all aquatic life. However, unlike terrestrial communities, where most autotrophs are plants, phytoplankton are a diverse group, incorporating protistan eukaryotes and both eubacterial and archaebacterial prokaryotes. There are about 5,000 known species of marine phytoplankton. How such diversity evolved despite scarce resources (restricting niche differentiation) is unclear. In terms of numbers, the most important groups of phytoplankton include the diatoms, cyanobacteria and dinoflagellates, although many other groups of algae are represented. One group, the coccolithophorids, is responsible for the release of significant amounts of dimethyl sulfide (DMS) into the atmosphere. The production of plankton varies from season to season and even day to day in tropical region. The rate of production of phytoplankton depends on diet, tide, season and region. In any series of programme of study especially in the field of aquatic biology of the desirability of obtaining much more intimate knowledge of plankton becomes obvious. Hence, an analysis of phytoplankton becomes essential in any investigation relating to hydrobiology.

Hence, the present attempt has been made to study the influence of physico-chemical natures of Paravanar estuary's water on the aquatic phytoplankton population diversity with the following prime objectives.

* Collection of phytoplankton population phytoplankton population samples from two different sites of Paravanar estuary located in Poondiyankuppam, Cuddalore District, Tamil Nadu State.

*Identification of phytoplankton population present in the samples.

*Analysis of physico-chemical parameters of Paravanar estuary water.

2. REVIEW OF LITERATURE

A review of previous work presented herein by design is restricted to important and recent studies on the diversity of phytoplankton in estuary water, their the physico-chemical parameters of estuary water in the diversity and the biomass of phytoplankton since a complete review is impossible.

Estuaries are the coastal wet lands comprising the interface region between freshwater and marine water and these are characterized by the variety of mutually interacting physical, chemical and biological processes resulting in important productive zones. In the tropical region high temperature and seasonal variations as well as salinity are the major factors determining the structure and functioning of the community dynamics in estuaries. Salinity of estuarine water is always higher than freshwater and lower than marine water. The high nutrient contents of estuaries support diversity of organisms (Joishi, 2014).

PHYSICO- CHEMICAL PARAMETERS

Analysis of physico-chemical parameters of water is essential to assess the quatily of water for the best usage like irrigation ,drinking ,bathing ,fishing ,industrial processing and so on. In India, large numbers of studies on imnologe of lentic water bodies have been carried out in past 30 years (Raghunathan *et al*., 2000). Uchijima (1963) invesgated annual variations in water temperature and heat balance in shallow water with no rice plants and evaluated the climatic aspects of seasonal and spatial variations of paddy water temperature in Japan by using simplified heat balance equation.

Sreelekshmi and Benno pereira (2017) studied about Physico- chemical parameters and plankton diversity were investigated from Vellayani Lake along with the condition factor of *Devario* species.

Hydro biological parameters like temperature, pH, dissolved oxygen, carbon dioxide, nitrate, phosphate and sulphate were analysed and noticed to be within standard limit of inland surface water quality by CPCB (2008), indicating uniformity in water quality parameters between stations in the lake. Generic level examination of plankton revealed four families of phytoplankton consisting of 25 genera viz, cyanophyceae (8 genera), basillariophyceae (8 genera), chlorophyceae (6 genera), euglinophyceae (3 genera). Zooplankton includes protozoans, rotifers and crustaceans.

The temperature optimum for many eukaryotic algae (Castenholz and Waterbury, 1989). Subhashini and Kaushik (1984) reported that the pH of the alkaline soil decreased when treated with cyanobactria. Nayak and Parasanna (2007) investigated the cyanobacteria and reported that they were more in number at high pH in rice fields. Cyanobacteria have been found to not only grow in higher salion-alkali soilds, but also improve the physico-chemical properties of the soil by enriching them with carbon, nitrogen and available phosphorus (Kaushik, 1994).

Physico-chemical variables in the marine environment are subjected to wide spatio- temporal variations. The various physico-chemical parameters viz., temperature, salinity, pH, dissolved oxygen and nutrients of the environment are the factors, which mainly influence the production and successful propagation of planktonic life in the coastal biotopes (Santhosh Kumar and Ashok Prabu, 2014)

Behera *et al*., 2014 physico-chemical parameters of water samples were compared with the water quality standard of Bureau of Indian standard and the state pollution control board. Variations of different parameters investigated were as follows: Temperature (24.2-30.9°C), dissolved oxygen (2.9-10.9 mg/L), pH (6.05-8.6), electrical conductivity (5.16–17.33 mS/cm), TDS (4510–11900 mg/L), chloride content (4389-12575 mg/l), nitrate (13.03-24.01 mg/l), phosphate (0.55-2.59 mg/l), calcium (125.4-400.8 mg/l), magnesium (153.16-474.13 mg/l) and total hardness (800-2090 mg/l). The significant variations of p among different study sites with high load of calcium, chloride, nitrate and phosphate in most of the study sites indicating the pollution status of the estuarine water.

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In any ecosystem, not a single species grows independently and indefinitely, because all the species are interlinked and has cyclic transformation of nutrients. The physicochemical changes in the environment may affect particular species and induce the growth and abundance of other species, which leads to the succession of several species in a course of time.

The abundance of cyanobacteria is attributed to favorable contents of oxidizable organic matter and less dissolved oxygen and cyanophyceae grow luxuriantly with great variety and abundance rich in calcium in possibly one of the factors. Besides calcium, high amount of oxdisable organic matter, traces of dissolved oxygen, considerable amount of nitrate and phosphate were the favouring the growth of cyanobacteria (Vijayakumar Madhumathi and Subramaniyan Vijayakumar, 2013)

Species of cyanobacteria are widely distributed in nearly all type of soils. The species present may be specialized to particular habitats, but may still be quite broadly distributed geographically (Starks *et al*., 1981). Differences among plant communities, soil types an local physic-chemical conditions affect the composition and abundance of algal taxa in soils. The most commonly reported factor that favours cyanobacteria in soils appears to be higher pH (King and Ward, 1977).

PHYTOPLANKTON DIVERSITY

Joishi (2014) studied species diversity of cyanobacteria found in the two estuaries of Western Ghat region and rare species, such as *Anabaena orientalis, Lyngbya semiplena, Merismopedia aeruginaea and Oscillatoria foreaui* were identified. Sivakamasundari *et al*. (2013) studied cyanobacterial biodiversity from three different areas of Paravanar estuary, In addition, certain physico-chemical parameters of estuary waters such as dissolved oxygen, pH, nitrate, nitrite, total phosphorus, inorganic phosphorus etc., were also analyzed and statistically compared with the cyanobacterial diversity.

Jyoti sharma *et al*., 2015, reported the spatial and temporal distribution of phytoplankton with respect to the changes in various physico-chemical parameters of Dongarwada ghat of river Narmada Madhya Pradesh. The study was carried for a year from March 2010 to February 2011.The results revealed presence of total 27 taxa of phytoplanktons belonging to 4 families were found in order of *Chlorophyceae* (47%) >*Cyanophyceae*

(27%) >*Bacillariophyceae* (23%)>*Euglenophyceae* (3%).

Makhlough *et al*., 2017 reported that, study showed that the dominant species and along with it their sizes and forms remained quite similar in the fall of different years, but the greatest shift in size and form were observed during spring, summer and winter. It is suggested that these changes reflect an ecological disturbance and instability in the Caspian environment.

Divya Tyagi and Malik, (2017) reported that, to assess the status of phytoplankton diversity and biomass in order to know the productivity of Ram-Ganga reservoir. A total 31 species were recorded out of which 14 were Chlorophyceae, 9 Bacillariophyceae and 8 Cyanophyceae. This study revealed maximum percentage wise composition, the highest number of Chlorophyceae (50%) in lower zone, Bacillariophyceae (35%) in the middle zone I and the number of cyanophyceae (20%) in lower zone.

Vijayakumar Madhumathi and Suburamaniyan Vijayakumar (2013) reported the survey of plankton flora from 10 different sites of Samuthiram lake in Thanjavur and studied the physico-chemical parameters of water such as dissolved oxygen, pH, carbonate, bicarbonate, nitrite, nitrate, total phosphorus and inorganic phosphorus. Amit Kumar and Radha Sahu (2012) studied the distribution of Chlorophyceae (Green algae) in paddy fields of Lalgutwa area, Ranchi, with special reference to seasonal variation and revealed that comparatively lesser number of Chlorophycean members was found in summers when compare to winter seasons. Mohammad Basha Makandar and Ashish Bhatnagar (2010) studied the biodiversity of microalgae and cyanobacteria from different freshwater bodies of Jodhpur and compared their variations in terms of physicochemical and diversity indices.

Jyoti Sharma *et al*., 2015 studied Dogarwada Ghat of River Narmada, that the results revealed presence of total 27 taxa of phytoplanktons belonging to 4 families were found in order of *Chlorophyceae* (47%) >*Cyanophyceae* (27%) >*Bacillariophyceae* (23%)>*Euglenophyceae* (3%).Diversity parameters Shannon index ranged from 1.092-0.37.

Anyinkeng *et al*., 2016 study about to determine the phytoplankton diversity and abundance in water bodies exposed to different anthropogenic pressures. Water samples were collected from 19 water sources in four categories: Car wash, Municipal wastes, Car wash + Municipal wastes and Drinking water. Phytoplankton species were determined following standard procedures. Palmer's pollution index was used to evaluate the status of organic pollution. A total of 66 phytoplankton were identified belonging to 44 genera, 34 families and six phyla.

Ramesh *et al*., 2016, the physico-chemical parameters play a major role in determining the density, diversity and occurrence of phytoplankton in a headwater stream. The present study was conducted to assess the relationship between physico-chemical parameters and phytoplankton assemblages of Baldi stream of Garhwal Himalayas, India. Results showed an increased concentration in physico-chemical parameters (turbidity, total dissolved solids, nitrates and phosphates) has an adverse impact on the density of phytoplankton during monsoon season at the sampling site S_2, where maximum disturbances were recorded.

In past few decades of research on cyanobacteria were of academic interests only and were mostly ignored as nuisance but, now is proved as potential for many biotechnological utilization (Thajuddin and Subramanian, 2005). Therefore, for several reasons, estimation and conservation of cyanobacterial biodiversity from yet unexplored habitats become very important, which need to be initiated with systematic survey followed by establishment of pure culture collection and their characterization.

Vivin silvaliandra sihombing *et al*., 2017 reported to assessing the diversity, evenness, and structure of fish, plankton and benthos communities as an indicator of the effectiveness of the rehabilitation of the mangrove ecosystem. The fish, benthos, and plankton were collected and analyzed in the Biotrop Laboratories. Fish sampling was carried out using a gill net with mesh size of 25 mm, and with traps. Juvenile fish were collected using a fish net with mesh size of 15 mm, by combing the water column horizontally for 10-15 minutes in the morning and afternoon. For plankton sampling a net No. 25 was used, while samples of benthos were collected using an Ekman Grab sampler.

In general, very limited studies of freshwater phytoplankton were available and the information is restricted only to rice field soils of Assam and its neighboring states (Ahmed *et al,* 1999; Rout and Dey, 1999). Madhumathi *et al.* (2012) reported the filamentous cyanobacteria from the Thanjavur District, Tamilnadu, India. They also reported 18 species of cyanobacteria belonging to 11 genera and 4 families *viz.,* Nostocaceae, Scytonemataceae, Rivulariaceae, Stigonemataceae. Of these Cyanobacteria, Nostocaceae with 10 species were recorded as maximum occurance, followed by Stigonemataceae, Scytonemataceae each with 3 species and Rivulariaceae with 2 species. A rich blue-green-algal diversity of 64 species, with Oscillatoriales as the dominants (38%), is observed in Kuttanadu paddy fields (Dhanya Vijayan and Joseph George Ray, 2015).

3. MATERIALS AND METHODS

3.1. Description of sampling sites

The Paravanar estuary rises in the Vridhachalam Taluk of the Cuddalore District, and runs through Cuddalore and Chidambaram Taluks of the same district and debouches into the Bay of Bengal.

The Paravanar estuary is situated at Cuddalore (Lat. 11° 43 'N: Long 79° 49' E) (Map Fig.1). The Paravanar estuary is an open type estuary having semidiurnal tides, with the tidal effect extending up to a distance of about 6 km. The mean tidal level in this estuary is about 90 cm and the mximum level is about 120 cm. The average depth of paravanar estuary is about 350 cm near the mouth and 250 cm towards upstream. It forms a potential fishing ground with an annual average landing of about 2000 tones. Uppanar is a tributary of Gadilam river which originates from the foothills and runs for the distance of 95 km, joins with adjoining paravanar estuary forming Uppanar-Paravanar estuarine complex and confluenceing into the Bay of Bengal.

Site- I

It is located nearest to the Sangolikuppam Village and from the estuarine mouth, it is about 7km distance. There are many acres of paddy fields on either side of the site. Plenty of fresh water is discharged from paddy fields in to estuary. Due to high tide, this site is getting a moderate salinity. The average depth of this site is about three meters. The mean salinity is ranged between 17%^{O} and 26 %^{O}. The bottom of this site is characterised with mud deposits. Nearby estuary, on the westside of it, some chemical factories are located.

Site- II

This site is located Poondiyankuppam Village, and surrounded by paddy fields on three sides. This site receives a large amount of fresh water through a big canal from the Perumal Lake, which is located just about 4 km from this site. The depth of this site is about two meters. The minimum level of salinity is ranged between 2%^{O} and 3 %^{O}. The bottom of the site is characterised with mud deposits.

3.2. Collection of water and soil samples

Collection of water samples with mud were undertaken in Site I and II at monthly intervals over a period of one year from September 2023 to August 2024. Samples were collected from the study sites (Fig. l), just below the surface and transferred to the pre-cleaned polypropylene containers. After collection, all the samples were immediately brought to the laboratory and preserved in 4% formalin for further studies.

3.3. PHYSICO-CHEMICAL PARAMETERS

The physico-chemical parameters such as atmospheric temperature, soil temperature, pH, salinity, dissolved oxygen (DO), inorganic nitrate, inorganic nitrite, inorganic phosphorus and reactive silicate were analyzed from the water with mud soil samples during September 2015 to August 2016.

3.3.1. Atmospheric temperature

Atmospheric temperature was measured by using a mercury thermometer. Care was taken to obtain a constant reading and the temperature was recorded in Celsius scale during morning hours (7 AM to 10 AM).

3.3.2. Water and soil temperature

Water with mud soil temperature was measured by using a mercury thermometer. Care was taken to obtain a constant reading and the temperature was recorded in Celsius scale during morning hours (7AM to 10 AM).

3.3.3. Hydrogen ion concentration (pH)

pH was determined by using electrical digital pH meter.

3.3.4. Salinity

Salinity was estimated with the help of a refractometer (ERMA, Hand Refractometer, Japan), and the values were expressed in the unit of %o.

3.3.5. Dissolved oxygen

Dissolved oxygen was estimated by Winkler's method (Strikland and Parsons, 1972). 50 mL of sample was taken in a 250 mL glass stopper bottle. 1

mL of manganese sulphate and 1ml of alkaline potassium iodide solution were added to the sample. The bottle was shaken well and the precipitate was allowed to settle in the bottle. 1ml of concentrated sulphuric acids was added to dissolve the precipitate, 5 drops of freshly prepared starch indicator was added and the solution was titrated against standard sodium thiosulphate. The disappearance of dark blue colour is the end point. Dissolved oxygen values were expressed in mg/L.

For the analysis of nutrients, surface water samples were collected in clean polyethylene bottles, kept immediately in an icebox, and transported to the laboratory. The water samples were then filtered using a Millipore filtering system and analysed for inorganic nitrate, inorganic nitrite, inorganic phosphate, and reactive silicate adopting the standard procedures described by Strikland and Parsons (1972).

3.4. SAMPLES COLLECTION AND IDENTIFICATION OF PHYTOPLANKTON SPECIES

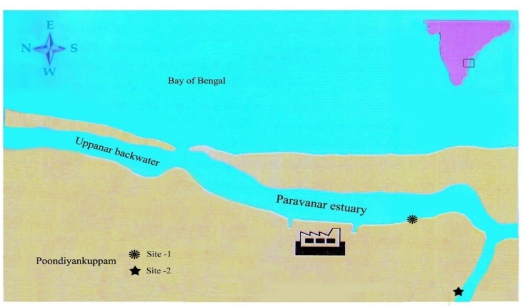

Fig. 1. Map showing the locations of sampling sites

Blue green algal samples were collected from two different sites (Site I & Site II) of paravanar estuary from September 2023 to August 2024. The collected blue green algae were brought to the laboratory and preserved in 4% formalin. The collected samples were examined for the identification of different species and screened for the presence of cyanobacterial members in particular. Algae that lost their color during preservation were examined after staining with aniline blue and other suitable stains. Samples were examined using light microscope and measurement was taken. Photomicrographs were taken using Nikon automatic photo micrographic unit. Each one litter water sample was also collected from the same sites for analyzing the physico-chemical and biological parameters, such as pH, dissolved oxygen, nitrate, nitrite, phosphorus and reactive silicate contents by using standard methods described in APHA, 1998. The phytoplankton species were identified with the help of classical manuals (Geitler, 1932; Desikachary, 1959; Iyengar and Desikachary, 1981; Anand, 1989 and Biswal and Das, 2004).

4. RESULT AND DISCUSSION

4.1. PHYSICO-CHEMICAL PARAMETERS

4.1.1. Atmospheric temperature

Atmospheric temperature varied between 27 to 36°C during the study period. At site I, the minimum temperature 27°C was recorded during the monsoon in November and December 2015 and at site II, the minimum atmospheric temperature 29°C was recorded during the monsoon in December 2023, whereas the maximum temperature 35°C was recorded during the summer in May 2024 at site I. At site I, the maximum temperature 36°C was recorded during the summer in May 2024. (Table 1; Fig. 2)

4.1.2. Surface water temperature

Surface water temperature showed a variation between 24°C and 33°C during the study period. The minimum temperature 24°C was recorded during the monsoon in November and December 2023 at site I and 25°C during the monsoon in October 2015 at site II. On the other hand, the maximum temperature 33°C was recorded during the summer in May 2024 at site I and at site II, it was 33.5°C during the summer in May 2024(Tables 1; Fig.3).

4.1.3. Hydrogen ion concentration (pH)

The pH values varied between 6 and 6.6 during the study period (Fig. 4). At site I, the minimum pH value 6 was recorded during the monsoon in November 2023 and at site II, the minimum pH 6.3 was noticed during the monsoon in December 2023. The maximum value of pH 6.6 was recorded during the summer in June 2024 at site I and at site II, the maximum value of pH 7.7 was recorded during the summer in June 2024 (Tables 1; Fig. 4).

4.1.4. Dissolved oxygen

Dissolved oxygen level varied between 3.7 and 8.1 mg/L (Fig. 5). The minimum value 3.7 was recorded during the post monsoon in February 2023 at site I and in site II it was recorded as 5.3 mg/L in the post monsoon of February 2023. The maximum value of 8.1 mg/L was recorded during the monsoon in November 2023 at site I and at site II, it was 8.1 mg/L during the monsoon in November 2023 (Tables 1; Fig. 5).

4.1.5. Salinity

Salinity values ranged between 11 and 26.2 %o during the study period at both the sites. At site I, the minimum salinity 17%o was recorded during the monsoon in November and December 2023. At site II, the minimum of 11%o was recorded during the monsoon in November and December 2023, whereas the maximum salinity value of 26.2 %o was recorded during the summer in May 2023 at site I and at site II, it was recorded as 23 %o during the summer in May 2023 (Tables.l; Fig.6).

4.1.6. Inorganic nitrate (µM)

The Inorganic nitrate concentration varied between 15.3 and 52.2µM during the study period (Fig. 7). At site I, the minimum value of nitrate 15.3µM was recorded during the summer in May 2023 and at site II, the minimum nitrate value of 20.1µM was noticed during the summer in May 2023. The maximum value of nitrate 52.3µM was recorded during the monsoon in November 2023 at site I and at site II, the maximum value of nitrate 53.5µM was recorded during the monsoon in November 2023

4.1.7. Inorganic nitrite (µM)

The dissolved inorganic nitrite concentration varied from 0.51 to 5µM during the study period (Fig. 8). At site I, the minimum value of nitrite 0.51µM was recorded during the summer in May 2023 and at site II, the minimum nitrite 0.55µM was noticed during the summer in May 2023. The maximum value of nitrite 5µM was recorded during the monsoon in November and December 2023 at site I and at site II, the maximum value of nitrite 6.3µM was recorded during the monsoon in November 2023.

4.1.8. Inorganic phosphate (µM)

The dissolved inorganic phosphate concentration varied from 0.53 to 6.3µM during the study period (Fig.9). At site I, the minimum value of phosphate 0.53µM was recorded during the summer in May 2023 and at site II, the minimum phosphate 0.56µM was noticed during the summer in May 2023. The maximum value of phosphate 5.1µM was recorded during the monsoon in November 2023 at site I and at site II, the maximum value of phosphate 6.3µM was recorded during the monsoon in November 2023.

4.1.9. Reactive silicate (µM)

The reactive silicate concentration varied from 80.1 to 149.3µM during the study period (Fig.10). At site I, the minimum value of silicate 80.6µM was recorded during the summer in May 2023 and at site II, the minimum silicate 82.6 µM was noticed during the pre monsoon in August 2024. The maximum value of silicate 134.2 µM was recorded during the monsoon in November 2023 at site I and at site II, the maximum value of silicate 149.3 µM was recorded during the monsoon in November 2023.

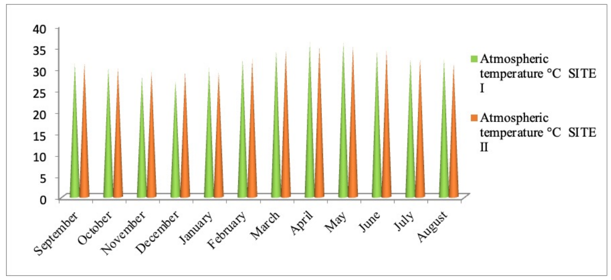

Fig. 2. Monthly variations of Air Temperature at Sites I & II

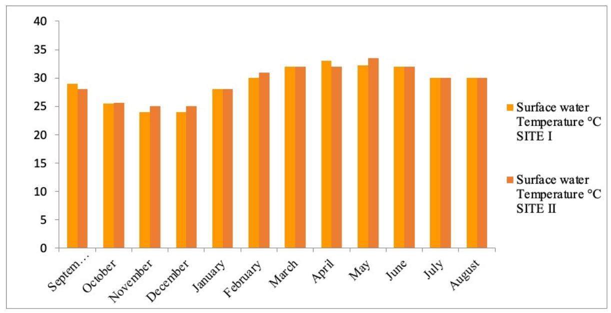

Fig. 3. Monthly variations of Surface Water Temperature at Sites I & II

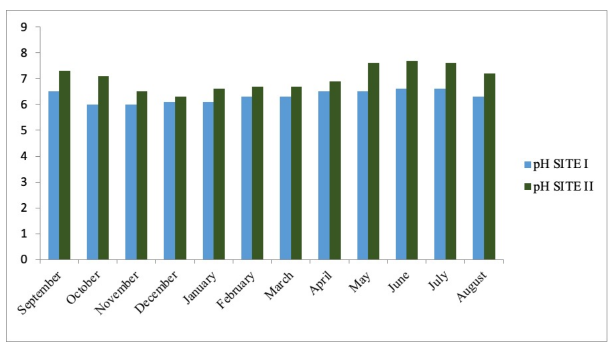

Fig. 4. Monthly variations of pH at Sites I & II

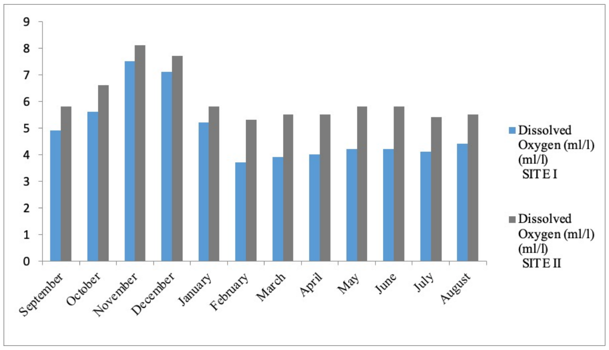

Fig. 5. Monthly variations of Dissolved Oxygen at Sites I & II

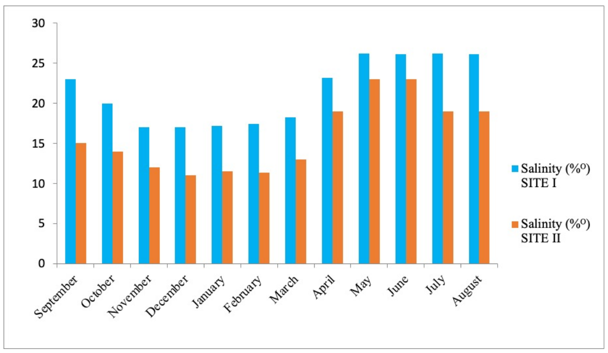

Fig. 6. Monthly variations of Salinity at Sites I & II

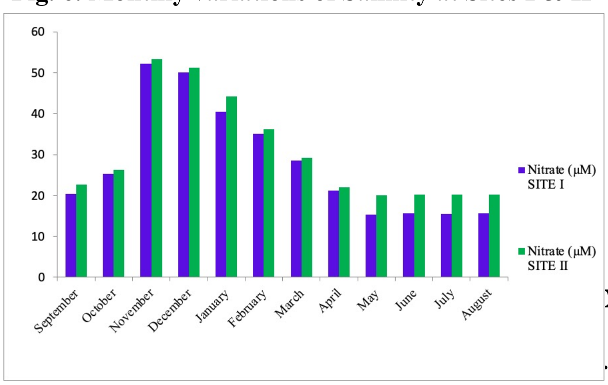

Fig. 7. Monthly variations of Inorganic Nitrate at Sites I & II

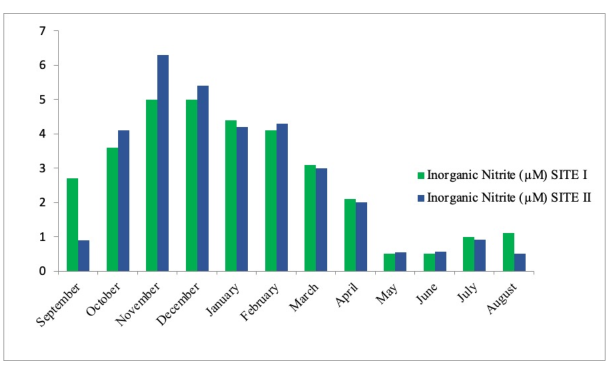

Fig. 8. Monthly variations of Inorganic Nitrite at Sites I & II

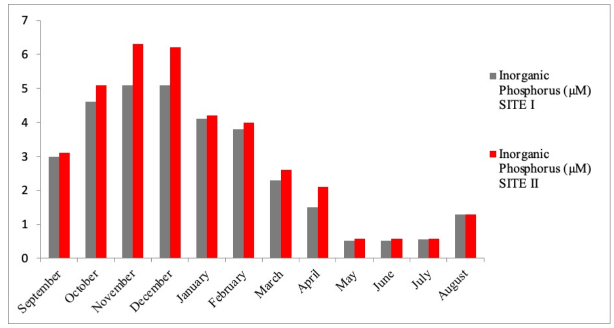

Fig. 9. Monthly variations of Inorganic Phosphorus at Sites I & II

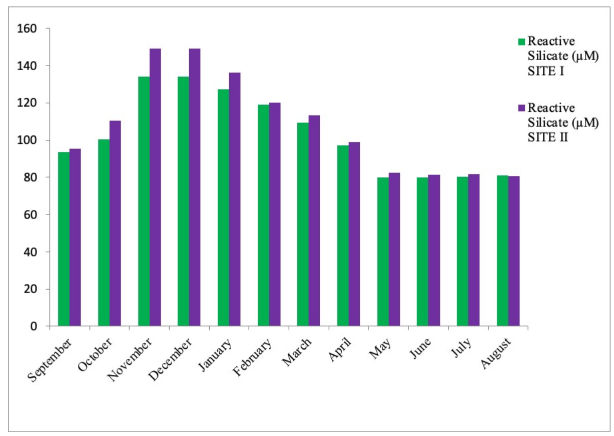

Fig. 10. Monthly variations of Reactive Silicate at Sites I & II

RSITY OF PHYTOPLANKTON IN PARAVANAR ESTUARY

sity of Phytoplankton species

A total of 58 species of phytoplankton were identified from the two study sites (Table 2) of Paravanar estuary during the study period. Out of 58 species identified, 34 species belonged to Bacillariophyceae (diatoms), 13 species to Dinophyceae (Dinoflagellates), 6 species to Cyanophyceae (Blue-greens), 4 species to Chlorophyceae (Green) and 1 species to Chrysophyceae (Silicoflagellates).

At site I, 25 species of Bacillariophyceae (diatoms), 8 species of Dinophyceae (Dinoflagellates), 6 species of Cyanophyceae (Blue-greens), 2 species of Chlorophyceae (Green) and 1 species Chrysophyceae (Silicoflagellates) were recorded.

At site II, 29 species of Bacillariophyceae (diatoms), 9 species of Dinophyceae (Dinoflagellates), 4 species of Cyanophyceae (Blue-greens), and 4 species of Chlorophyceae (Green) were recorded. Among the genera isolated from both of the sites, Chaetoceros with 4 species and Coscinodiscus with 5 species were found to be dominant genus in site 1 and 2. The rest of the genera had single species each. Morphological descriptions, common habitats and distribution of identified species were described and represented systematically.

Table 2. Phytoplankton diversity in two different sites recorded from September 2023 to August 2024 at Paravanar estuary

S.No.	Name of the species	Site I	Site II
	BACILLARIOPHYCEAE (DIATOMS)		
1	***Amphoro coffeaeformis.***	+	+
2	***Asterionella japonica***	-	+
3	***Bacteriastrum comosum.***	-	+
4	***B. hyalinum***	+	+
5	***Biddulphia heteroceros***	+	+
6	***B. sinensis***	+	-
7	***Chaetoceros affinis***	-	+
8	***C. didymus***	+	+
9	***C. diversus***	-	+
10	***C. peruvianus***	+	+
11	***Coscinodiscus centralis***	+	+
12	***C. eccentricus***	-	+
13	**C. gigas**	+	+
14	***C. radiatus***	+	-
15	***C. sublineatus***	+	+
16	***Cyclotella* sp**	+	+
17	***Ditylum brightwellii***	+	+
18	***Eucampia zoodiaacus***	+	+
19	***Fragillaria oceanica***	+	-
20	***Guinardia flaccida***	-	+
21	***Hemidiscus hardmanianus***	-	+
22	***Lauderia annulata***	+	+
23	***Melosira sulcata***	+	+
24	***Navicula granulata***	+	+
25	***Nitzschia closterium***	-	+
26	***Pleurosigma destuarii***	+	+
27	***P. elongatum***	+	-
28	***Rhizosolenia cylindricus***	+	-
29	***R. imbricata***	+	+
30	***Skeletonema costatum***	+	+
31	***Streptotheca indica***	+	+
32	***Thalassiosira decipiens***	+	+
33	***Thalassiothrix frauenfeldii***	+	+
34	***T. longissima***	-	+
	DINOPHYCEAE (DINOFLAGELLATES)		
35	***Ceratium breve***	+	-
36	***C. fusus***	-	+
37	***Dinophysis caudata***	+	+
38	***D. hastata***	+	+
39	***Goniaulax digensis***	+	-
40	***Gymnodinium breve***	+	-
41	***Ornithocercus steinii***	-	+
42	***Noctiluca scintillans***	-	+
43	***Protoperidinium pellicidum***	+	-
44	***P. pentagonium***	-	+
45	***P. venustum***	-	+
46	***Pyrocystis fusiformis***	+	+
47	***P. pseudonactiluca***	+	+
	CYANOPHYCEAE (BLUE-GREENS)		
48	***Anabaena sp***	+	-
49	***Microcystis sp***	+	+
50	***Nostoc linkia***	+	+
51	***Oscillatoria sp***	+	-
52	***Spirulina meneghiniana***	+	+
53	***Trichodesmium erythraea***	+	+
	CHLOROPHYCEAE (GREEN)		
54	***Chlorella vulgaris***	+	+
55	***Pediastrum sp***	+	+
56	***Spirogyra indica***	-	+
57	***Volvox sp***	-	+
	CHRYSOPHYCEAE (SILICOFLAGELLATES)		
58	***Distephanes speculum***	+	-

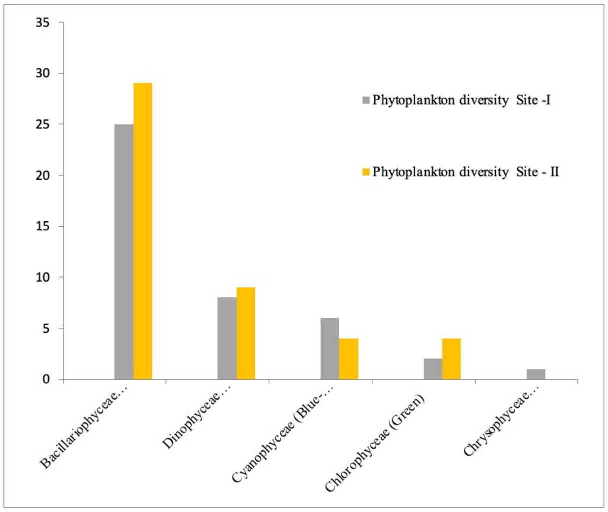

Fig. 11. Phytoplankton diversity at Sites I & II

CONCLUSION

The water quality parameters of Paravanar estuary were observed to be within possible physico-chemical parameters. The quality of water at every station was uniform. Phytoplanktons were identified up to genus level. The higher diversity of basillariophyceae was recorded among phytoplankton community. The study it is evident that both abiotic and biotic factors of the estuary are capable for providing a better condition for phytoplankton species in the estuary. Phytoplankton occurrence is high and diverse among water sources. The pollution status of these sources also varies with different anthropogenic activities. The study provides baseline data for future evaluation while recommending improved management of water sources in the nearby factories effluents.

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