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RESEARCH ARTICLE

MONTHLY VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS IN UPPANAR ESTUARY SOUTH EAST COAST OF CUDDALORE DISTRICT, TAMIL NADU, INDIA

¹Ramesh, A., ¹Kalimuthu, D., ²Rengarajan, R. and ^{1,*}Sukumaran, M.

¹P.G and Research Department of Zoology, Rajah Serfoji Government College, Thanjavur - 613 005,
Tamil Nadu, India

²Department of Zoology, Govt. Arts College, Ariyalur, Tamil nadu, India

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ABSTRACT

Monthly fluctuations of physico-chemical characteristics were carried out in Uppanar estuary south east coast of Cuddalore District, Tamil Nadu, India, for a period of twelve months (January 2017 to December 2017). Eight various physico-chemical parameters were analyzed by using standard methods (APHA, 1998). Water temperature varied from 23.62 to 31.05°C, pH ranged from 7.62 to 8.42. Turbidity was from 35.75 to 53.02 cm, Dissolved oxygen content varied between 4.24 to 6.23 mg/L, salinity (17.27 to 26.27 ppt), calcium (123.15 to 244.45 mg/L), nitrate (0.40 to 0.59 mg/L) and ammonia (0.04 to 0.17 mg/L) also varied independently.

Key words: Physico-chemical characteristics, Monthly variations, Estuary, Water quality.

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INTRODUCTION

An estuary may be defined as a water body in which river water mixes with and measurably dilutes the sea water. The water of the estuary is called brackish water, just to distinguish it from the freshwater of the river and the marine water of the sea. It is an ecosystem of the river or that of the sea. 9.47 lakh hectares water area, is in the shape of brackish water in our country. Tidally influenced ecological systems where rivers meet the sea and fresh water mixes with salt water are estuaries. Estuaries are providing thousands of birds, mammals, fishes and other wildlife depends on estuaries. Many marine organisms, most commercially valuable fish species included, depend on estuaries at some point during their development. A healthy, untended estuary produces from four to ten times the weight of organic matter produced by a cultivated corn field the same size. Estuarine environmental study has accelerated during the past two decades since estuaries support a rich pelagic, benthic communities and serves as excellent nursery and feeding grounds for many commercially important fishes and shrimps. They also form the centres for natural seed collection of most of the commercially important fin fishes and shell fishes suitable for aquaculture. The physico-chemical characteristics of the aquatic environment directly influence the life inhabiting it.

Fluctuation in these constituents often create an adverse environment to organisms, limiting their growth and interfering in the physiological processes, which reduce their ability to compete with other populations within the environment, ultimately changing the community structure (Kedar and Patil, 2011). Tamil Selvan and John Milton, (2016) has been undertaken to enlighten the water quality parameters of coastal water of East coast of Tamil Nadu and the Chennai city was selected as the reference site. The reason for chosen the coastal water level due to the continuous discharge of domestic sewage and industrial effluent in the estuary.

The physico-chemical constituents in Indian estuaries both in east and west coastal zone reveal wide seasonal fluctuation. In are monsoon, the estuaries were dominated with fresh water inflows from adjacent rivers and tributaries through land drainages. Whole in the non-monsoon season, the estuarine water showed predominantly saline characteristics. The concentration of various parameters was governed by river water flow, sea water intrusion, urban sewages, metal toxic concentration. The spatial distribution of toxicants was regulated by estuarine circulation mixing and other physical process together with biological, sediment logical and chemical effects. Many reports available on the studies of physico – chemical characteristics of varied estuaries support these concepts (Govindasamy et al., 2000; Saravanakumar et al., 2008; Vengadesh Perumal et al., 2009 and Anitha et al., 2013).

***Corresponding author:** Sukumaran, M.,

P.G and Research Department of Zoology, Rajah Serfoji Government College, Thanjavur - 613 005, Tamil Nadu, India.

In the present study attempts to provide such vital information for future references. All the physico-chemical parameters were studied from Uppanar estuary south east coast in Cuddalore area and District, Tamil Nadu, India for a period of January 2017 to December 2017.

MATERIALS AND METHODS

Water samples were collected from Uppanar estuary south east coast of Cuddalore District, Tamil Nadu which is located at latitude 111.15° 05' North South and longitude 79 .84° 5' East West on Southern part of India. 2 litre capacity of plastic cans for physico-chemical samples were used to collect surface water samples and kept immediately in an ice box and transported to the laboratory. The samples were analyzed every month during January 2017 to December 2017. The various physico-chemical parameters were analyzed by using standard methods (APHA, 1998). Temperature : In the present study water temperature of the pond water recorded by using Mercury field celcius thermometer. pH : The pH was determined by using Elico, model LI. 120 Digital pH meter. Turbidity : It can be determined by using turbidity meter. Dissolved oxygen : The Dissolved oxygen was determined by the modified Winkler's method (1888). Salinity : The salinity content was determined by Mohr's titration method. The other parameters like, calcium estimated by EDTA Titrimetric method, The nitrate was determined by the Brucinemethod and ammonia was determined by the nesslerization method (APHA, 1998).

RESULTS

In the present study, the water temperature fluctuated from 31.05 to 23.62°C in Uppanar estuary. It was found to be low (23.62°C) in the month of December 2017 and high (31.05°C) in May 2017 (Table 1 and Fig. 1). Turbidity of the estuarine water depends on availability of either zooplankton or phytoplankton and suspended soiled particles. The transparency of the estuary varied from 35.75 to 53.02 cm. It was found to be low (35.75cm) in the month of December 2017 and high (53.02 cm) in the month of July 2017 (Fig. 2). pH is another important biological parameter. The pH of the estuarine water showed alkaline ranges throughout the study period. It varied from 7.62 to 8.42. It was found to be minimum (7.62) in December 2017 and maximum (8.42) in the month of May 2017 (Fig. 3).

The salinity content ranged from 17.27 to 26.27 ppt. It was found to be high (26.27 ppt) in the month of August 2017 and low (17.27 ppt) was recorded in December 2017 (Fig. 4). The dissolved oxygen is important biological factor. The dissolved oxygen content in estuary ranged from 4.24 to 6.23 mg/L. It was found to be low (4.24 mg/L) in June 2017 and high (6.23 mg/L) in November 2017 (Fig. 5). Calcium content in the estuary fluctuated from 123.15 to 244.45 mg/L. It was found to be low (123.15 mg/L) in the month of December 2017 and high (244.45 mg/L) in June 2017 (Fig. 6). Nitrate content was fluctuated from 0.40 to 0.59 mg/L. It was found to be low (0.40 mg/L) in the month of December 2017 and high (0.59 mg/L) in July 2017 (Fig. 7). The ammonia content ranged from 0.04 to 0.17 mg/L. It was found to be low (0.04 mg/L) in the month of October 2017 and high (0.17 mg/L) in July 2017 (Fig. 8) Each value is the mean \pm S.D. of four observations.

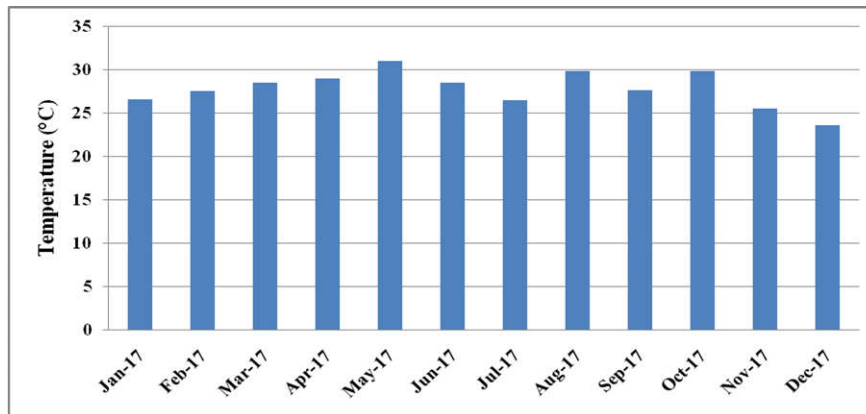
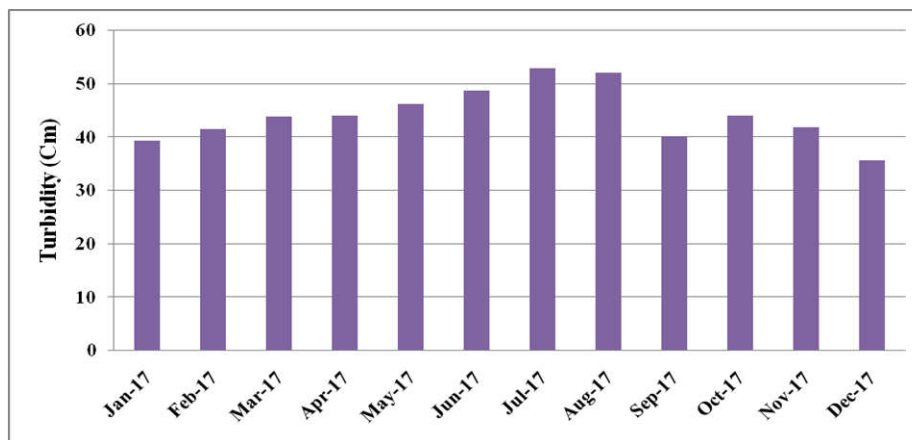
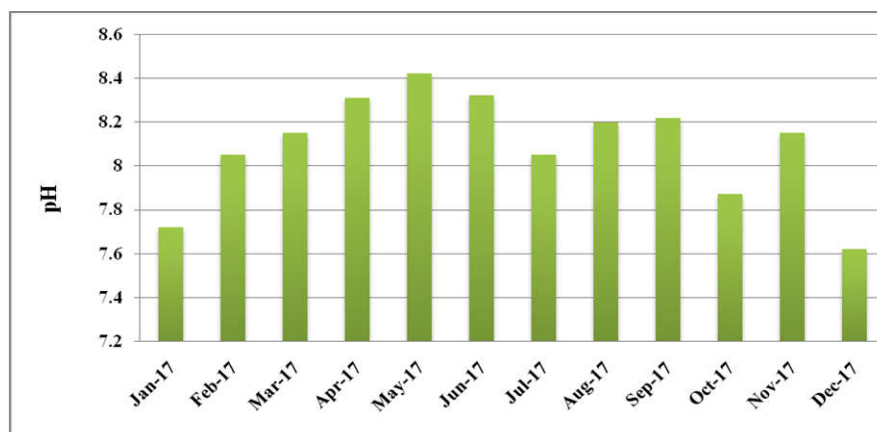
DISCUSSION

The water temperature during monsoon season (October to December) was low because of strong land sea breeze and precipitation and the recorded high value during summer season (April to June) could be attributed to high solar radiation (Sampathkumar and Kannan, 1998 and Ajithkumar *et al.*, 2006). The seasonal variation in the water temperature depends upon the wind force, freshwater discharge influx of the inshore water and atmospheric temperature (James BalganAnand and Mary Jelastin Kala, 2015). The results are coincides the present investigation. Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organism. Turbidity of the fresh water samples depends on availability of either zooplankton or phytoplankton and suspended soiled particles. Turbidity is the important factor in the estuarine environment. Turbidity is caused by the suspended particle in water brought about both biotic and abiotic factors. The turbidity of brackish water samples was found to be low in the post monsoon season and high in the pre-monsoon season during the study period of first year. It was found to be lowest in the monsoon season and highest in pre-monsoon season during the study period of second year. The results of the present study agreed earlier observations of Srivastava *et al.* (2003). Thommai Arockia Gaspar and Lakshman, (2014) reported that the monsoon time the level of turbidity is very high due to the estuary received rain water along with industrial waste and manmade waste. In summer, low level of turbidity was observed it may be due to the low level of inflow of fresh water. pH is an important factor that determines the suitability of water for various purposes including toxicity to aquatic organisms. The pH changes may be due to the variation in photo synthetic activities of aquatic organisms which increases due to consumption of dissolved CO₂ process (Begum and Harikrishna, 2008).

The recorded high pH value 8.31at Kanyakumari during summer season might be due to the influence of seawater penetration and high biological activity like photosynthesis by dense phytoplankton blooms (James Balgan Anand and Mary Jelastin Kala, 2015). Low value of pH is due to the metabolism of fungus and also metabolic production of acids by indigenous micro flora (Khan *et al.*, 2011). Similarly pH was low during monsoon and high during summer season in the Agniar estuary (Sukumaran *et al.*, 2013). The pH values ranged from 7.96 to 8.30. The minimum was recorded December, monsoon season and the maximum was observed June, summer season (James Balgan Anand *et al.*, 2015). Salinity is profoundly influences the abundance and distribution of the microorganism in the estuarine environment. Salinity is profoundly influences the abundance and distribution of the microorganism in the estuarine environment (Rault *et al.*, 2011). Manikannan *et al.* (2011) recorded a maximum salinity value during the summer and lower values during the wet (monsoon) season, which is a result of the heavy rainfall. Maximum salinity was recorded in summer especially in the months of May and June and minimum during monsoon particularly in the month of December for both the stations. In general the salinity was influenced by high temperatures of both atmospheric and water. During monsoon season, rainfall and freshwater inflow from the land were moderately reduced the salinity (Thirunavukkarasu *et al.*, 2011; Ananthan *et al.*, 2012; Balasubramanian and Kannan, 2005).

Table 1. Physico-chemical characteristics of Uppanar estuary (January 2017 to December 2017).

Month and Year	Temp. (°C)	Turbidity (cm)	pH	Salinity (ppt)	DO (mg/L)	Calcium (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)
Jan-17	26.62 ± 0.37	39.39 ± 0.37	7.72 ± 0.09	19.36 ± 0.35	5.48 ± 0.33	136.16 ± 2.42	0.45 ± 0.27	0.11 ± 0.01
Feb-17	27.6 ± 0.13	41.49 ± 0.27	8.05 ± 0.13	20.51 ± 0.23	5.12 ± 0.13	148.75 ± 0.49	0.47 ± 0.17	0.12 ± 0.01
Mar-17	28.57 ± 1.31	43.97 ± 0.89	8.15 ± 0.13	21.17 ± 0.75	4.83 ± 0.11	193.17 ± 2.77	0.48 ± 0.08	0.13 ± 0.008
Apr-17	29.07 ± 0.79	44.15 ± 0.75	8.31 ± 0.11	22.67 ± 1.12	4.51 ± 0.13	215.95 ± 2.74	0.51 ± 0.09	0.16 ± 0.008
May-17	31.05 ± 0.48	46.27 ± 0.61	8.42 ± 0.09	23.57 ± 0.54	4.35 ± 0.17	234.9 ± 1.33	0.58 ± 0.07	0.14 ± 0.01
Jun-17	28.57 ± 1.31	48.7 ± 0.65	8.32 ± 0.12	22.26 ± 0.76	4.24 ± 0.23	244.45 ± 0.96	0.56 ± 0.07	0.15 ± 0.005
Jul-17	26.57 ± 1.31	53.02 ± 1.25	8.05 ± 0.13	23.40 ± 1.41	4.46 ± 0.10	223.42 ± 1.08	0.59 ± 0.07	0.17 ± 0.01
Aug-17	29.95 ± 0.82	52.2 ± 0.91	8.2 ± 0.08	26.27 ± 0.59	4.61 ± 0.07	131.25 ± 0.96	0.53 ± 0.11	0.06 ± 0.008
Sep-17	27.71 ± 1.62	40.25 ± 1.26	8.22 ± 0.09	23.45 ± 1.26	4.53 ± 0.08	126.87 ± 1.31	0.50 ± 0.10	0.05 ± 0.005
Oct-17	29.92 ± 0.38	44.12 ± 0.85	7.87 ± 0.12	22.52 ± 1.04	5.03 ± 0.13	129.62 ± 1.11	0.48 ± 0.08	0.04 ± 0.009
Nov-17	25.62 ± 2.62	41.87 ± 1.31	8.15 ± 0.19	20.32 ± 0.80	6.23 ± 0.14	135.12 ± 1.03	0.45 ± 0.09	0.07 ± 0.02
Dec-17	23.62 ± 3.35	35.75 ± 1.21	7.62 ± 0.19	17.27 ± 0.76	5.19 ± 0.16	123.15 ± 0.87	0.40 ± 0.08	0.10 ± 0.009

**Fig. 1. Monthly variations of water temperature (°C) in the Uppanar estuary****Fig. 2. Monthly variations of water turbidity (cm) in the Uppanar estuary****Fig. 3. Monthly variations of water pH in the Uppanar estuary**

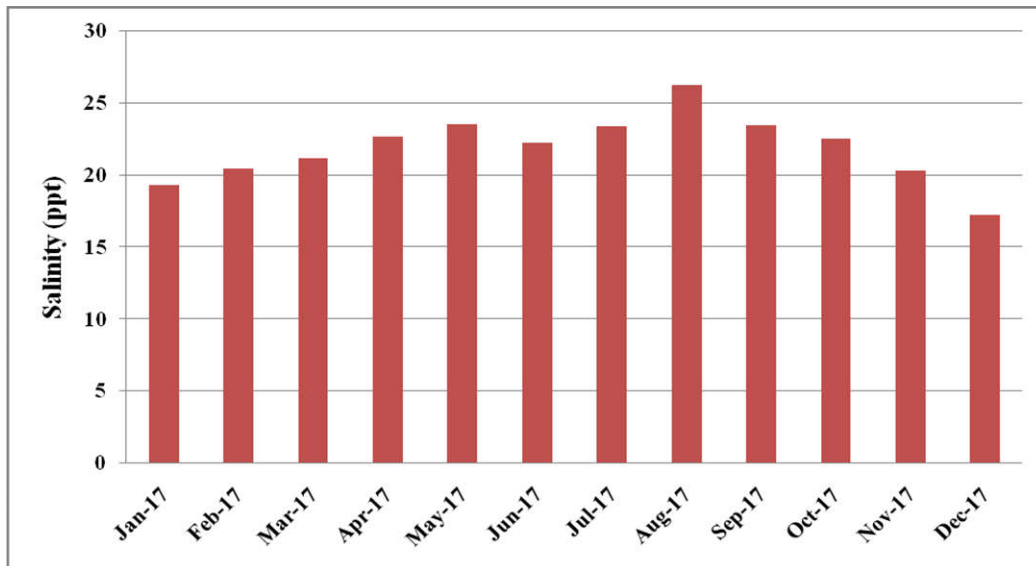


Fig. 4. Monthly variations of salinity (ppt) in the Uppanar estuary water samples

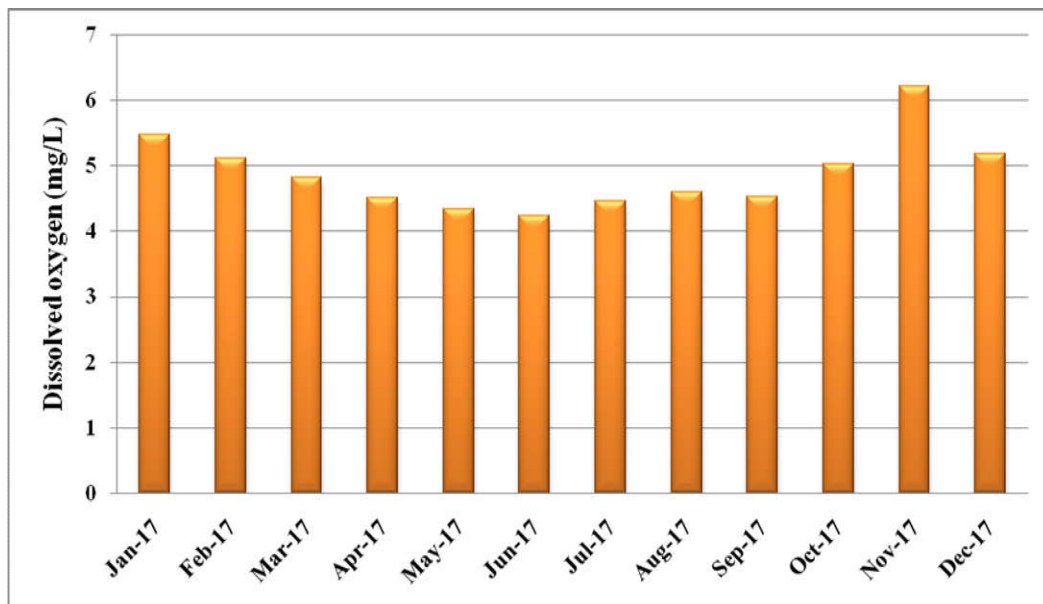


Fig. 5. Monthly variations of dissolved oxygen (mg/L) in the Uppanar estuary water samples

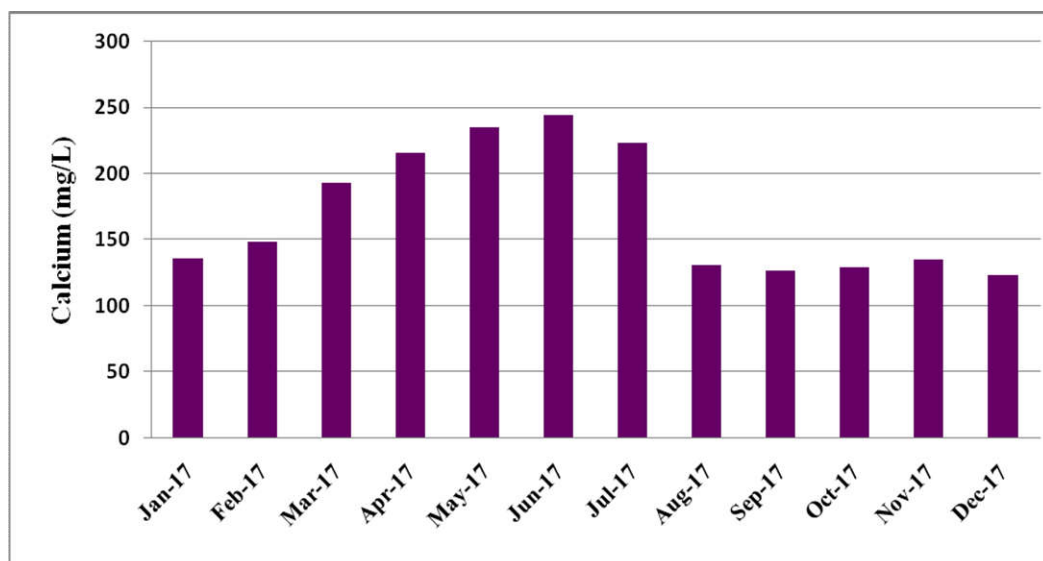


Fig. 6. Monthly variations of calcium (mg/L) in the Uppanar estuary water samples

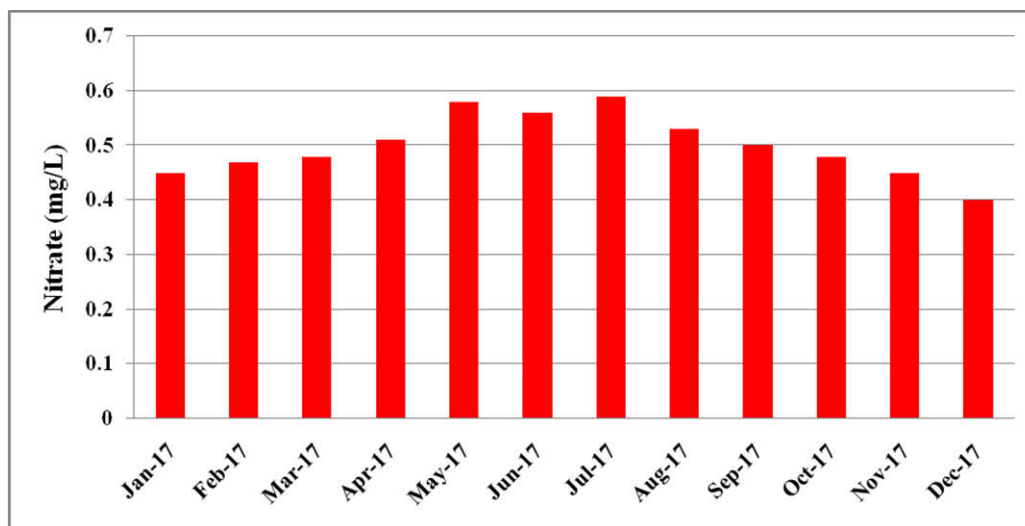


Fig. 7. Monthly variations of nitrate (mg/L) in the Uppanar estuary water samples

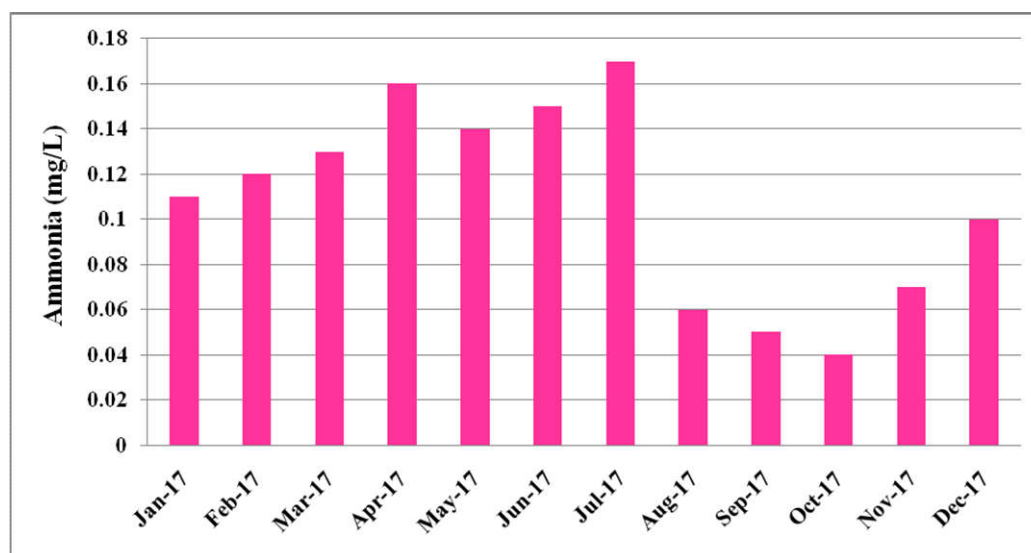


Fig. 8. Monthly variations of ammonia (mg/L) in the Uppanar estuary water samples

Similarly salinity was low during monsoon and high during summer season in the Agniyar estuary (Sukumaran *et al.*, 2013). Dissolved oxygen is one of the most important parameter. In the present investigation, the dissolved oxygen content in the fresh water sample maximum was observed in summer and minimum was recorded in post monsoon season of first year. The dissolved oxygen content was found to be low in summer season and high in post monsoon season of second year. Less amount of dissolved oxygen was recorded during the monsoon and the highest in the summer season due to increased photo synthetic activity in the water body (Shiddamallayya and Pratima, 2008). The high DO in summer is due to increase in temperature and duration of bright sunlight has influence on the % of soluble gases (O_2 and CO_2). During summer the long days and intense sunlight seem to accelerate photosynthesis by phytoplankton, utilizing CO_2 and giving off oxygen. This possibility accounts for the greater qualities of O_2 recorded during summer (Patil *et al.*, 2012). The high value of calcium noticed during monsoon season and low value was recorded during summer (Sridhar *et al.*, 2006). Lowest value of calcium recorded during monsoon season and calcium varies from 3.20 mg/L. to 408 mg/L. during monsoon season and 22.40 to 656 mg/L. during winter season (Francis Andrade *et al.*, 2011).

The maximum calcium was observed in May and minimum value in March. Calcium reached at peak in May and then show gradual decline was reported (Muhammad Naeem *et al.*, 2011). Nitrate is one of the important nutrients in fish culture ponds and is the common form of nitrogen in natural water. Nitrate is oxidized to nitrate after entering an aerobic regime. The increasing nitrates level was due to the freshwater in flow, litter fall decomposition and terrestrial runoff water during the monsoon seasons (Mathivanan *et al.*, 2008). Plants and micro organisms reduce nitrate into nitrite but nutrition is quickly oxidized back to nitrate once in reenters the water. The observed high monsoonal phosphate value might be due to the regeneration and release of total phosphorus from bottom solid into the water column by turbulence and mixing (Khairwal *et al.*, 2003). Sankar Narayan Sinha and Mrinal Biswas, (2011) reported the nitrate content of lake water fluctuated between 0.80 and 1.82 mg/L with the mean value of 1.14 mg/L. The maximum and minimum concentrations were recorded during September and November respectively. The higher nitrate-nitrogen (NO_3-N) concentration during the rainy season could be due to surface run-offs as well as the decomposition of organic matter. Ammonia and nitrogen was observed maximum in the monsoon and post-monsoon seasons due to rainfall and the river runoff carrying large amount of detritus

(Indirani *et al.*, 2010). The highest ammonia concentration was recorded during the dry season (Kaniz Fatema *et al.*, 2014) as a result of steaming from low precipitation. However, dilution of rainwater may be important in reducing the ammonium level in the estuary.

Conclusion

The present observation, the various physico-chemical parameters were noted in Uppanar estuary south east coast of Cuddalore District. The data which showed that the physico-chemical properties of the estuarine zone were significantly varied when compared with study period. Thus, it can be concluded that the variations water quality parameters determine in the Uppanar estuary south east coast of Cuddalore District during the study period.

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