

Physico-Chemical Parameters of Holy Places Agnitheertham and Kothandaramar Temple; Southeast Coast of India

*A. Mohamed Abubaker Sithik, G. Thirumaran, R. Arumugam,
R. Ragupathi Raja Kannan and P. Anantharaman*

CAS in Marine Biology, Annamalai University, Parangipettai - 608 502, Tamil Nadu, India

Abstracts: The present investigation was carried out the physico-chemical parameters of two holy places such as Agnitheertham and Kothandaramar kovil. The maximum (29.9 mm) rainfall was recorded during the month of April and the minimum (6.0 mm) was during the month of June. The maximum atmospheric temperature (29.5°C) was observed maximum in the month of May and July and the minimum atmospheric temperature (28.0°C) was recorded during the month of June at both the stations. The surface water temperature (°C) ranges between 29.0 to 27.0°C. The salinity (‰) ranges from 35 ppt-33 ppt, the pH values ranges from were 8.3 to 8.0 and the Dissolved oxygen (ml/l) concentration ranges from 4.99 ml/l to 3.87. at Station 1 and 2 respectively. The Inorganic nitrate concentration (μ) ranges from 0.62-0.15 at station 1 and 0.64 to 0.08 at station 2. The reactive silicate (μ) content varied between 22.16-19.60 at station 1 and 23.58 to 18.11 at station 2. The Inorganic nitrate concentration (μ) ranges from 0.62-0.15 at station 1 and 0.64 to 0.08 at station 2. The Inorganic nitrate concentration (μ) ranges from 6.24-3.53 at station 1 and 7.52 to 2.52 at station 2. The ammonia concentration (μ) ranges from 2.15-0.08 at station 1 and 1.80 to 0.05 at station 2 correspondingly.

Key words: Physico-Chemical parameters • Agnitheertham • Kothandaramar koil • Holy places and Southeast coast of India

INTRODUCTION

Water is the universal solvent required for all the living beings. Without the knowledge of water quality, it is difficult to understand the biological phenomenon fully, because the chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydrobiological inter-relationship. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take water as an environment.

Hydrobiological studies are the important one associated with flora and fauna of the marine and estuarine environment. Maintenance of good water quality is essential for the survival of the aquatic communities in the coastland and wetland environments [1].

The level of nutrients determines the potential fertility of the water masses and therefore it is important to gather information about their distribution and behavior in different coastal eco-systems. The distribution and behavior of nutrients in coastal

environment particularly in the near shore waters and estuaries exhibit considerable seasonal variations in relation to rainfall pattern, quantum of fresh water inflow.

MATERIALS AND METHODS

Study Area Description: The station is relatively less polluted as there are no river discharges and industrial wastes disposal. The domestic sewage alone is let out in to the sea and the human excreta on the sea shore mixes with the sea water. Rameswaram is a part of the southward extension of the Bay of Bengal as it meets the Indian Ocean (Fig. 1). It straddles across the two countries India and Srilanka. The Gulf of Mannar region from Rameswaram Island to Tuticorin. The Indian part of Gulf of Mannar covers approximately an area of 10,500 sq. kms lying between 08° 35N-09° 25N and 78° 08' E to 79° 30" E. It is unique for its heterogenous biological resources. The region is not more than 20 meter in depth. There are 21 islands covering of 625 hectares. The islands are classified into 4 groups, namely Mandapam group, Keelakarai group, Vembar group and Tuticorin group.

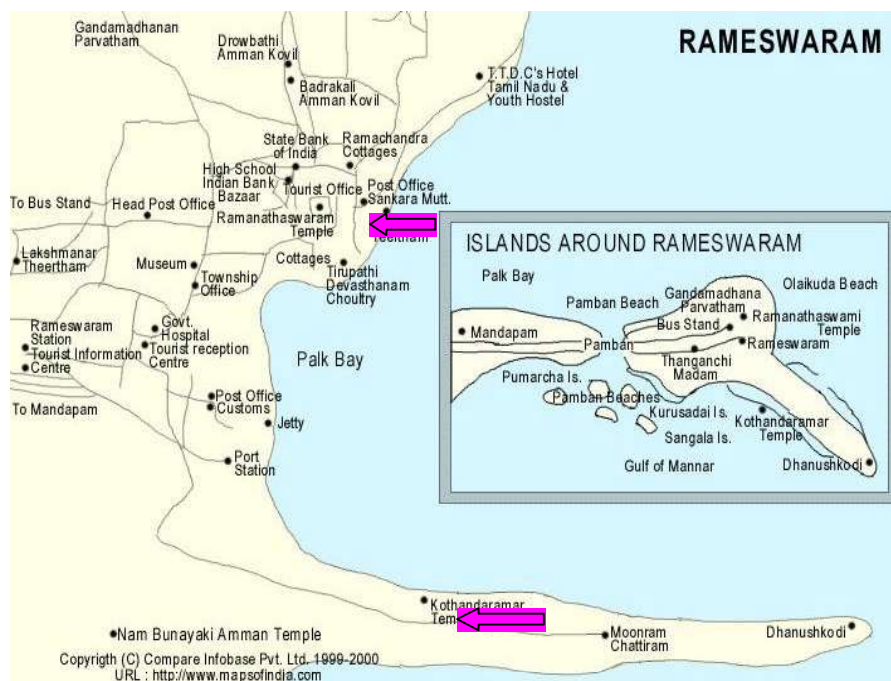


Fig. 1: Shows the Study Area Map of Rameswaram coast

The present study has been made extensively in the Gulf of Mannar Islands namely, Rameswaram Island. This island comes under the Mandapam group. The Gulf of Mannar is influenced by the south west and North east monsoon. Although the south west monsoon is rain during June to September, it does not bring to this coast much rain. The north east monsoon which is prevalent during October to December brings heavy rain fall to this area [2]. The tidal amplitude here is about 0.75m during the south west monsoon, the coastal waters in the Gulf of Mannar become turbulent owing to strong winds. Here the Mandapam is a major in the Palk Bay and more than 350 trawlers are being operated from this centre and download their catches.

The Agnitheertham (Station 1) Latitude $9^{\circ}17'26.8''\text{N}$ and the Longitude $79^{\circ}19'21.15''\text{E}$ is located opposite to the Ramanatha swami Temple. The characteristics of this station are, there is no river flow observed, polluted by human beings, via tourist activities and there is no industrial discharges mixed, but only the local domestic sewage discharged. The Kothandaramar kovil (Station2) Latitude $9^{\circ}13'10.07''\text{N}$ and the Latitude $79^{\circ}20'53.12''\text{E}$, about 17 Kilometers south east from Station 1. Just opposite to the Kothandaramaswamy Temple, comparatively less human influences than station1.

Physico-Chemical Parameters: Surface water samples were collected at monthly intervals from station 1 and 2 for a period of six months from April 2006 to September 2006. Rain fall data were obtained from the metrological unit (Govt. of India) Chennai. Temperature was measured using a standard centigrade thermometer. Salinity was estimated with the help of Refractometer (ERMA, Hand Refractometer, Japan) and pH was measured using an ELICO Grip pH meter. Dissolved Oxygen was estimated by the modified Winkler's method [3] and expressed as ml/l. For the analysis of nutrients, surface water samples were collected in clean polyethylene bottles and kept immediately in an ice box and transported to the laboratory. The water samples were then filtered using Millipore filtering system and analysed for phosphate, reactive silicate, dissolved organic nitrate, nitrite, ammonia and adopting the standard procedures described by [3] and expressed in μg .

Simple correlation co-efficient (r) analysis between different parameters and the Analysis of Variance (ANOVA) have been employed for the statistical interpretation of data obtained from the study is discussed.

Physico-Chemical Parameters: Monthly variations in meteorological and physico-chemical parameters viz., rainfall, atmospheric temperature, surface water

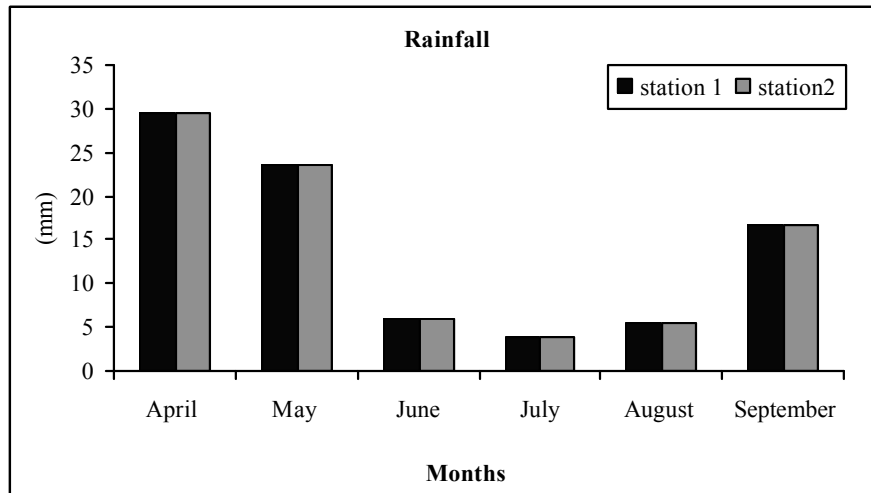


Fig. 2: Shows the Rain fall of Agnitheertham and Kothandaramar kovil

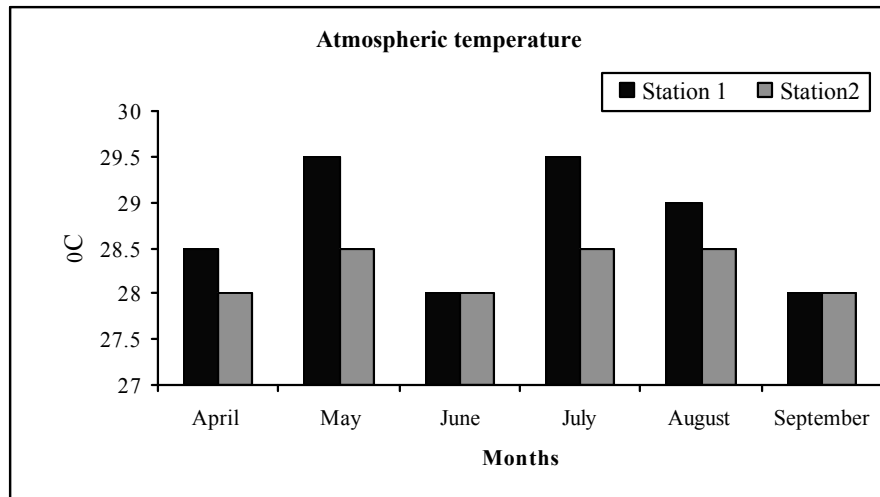


Fig. 3: Shows the Atmosphere Temperature of Agnitheertham and Kothandaramar kovil

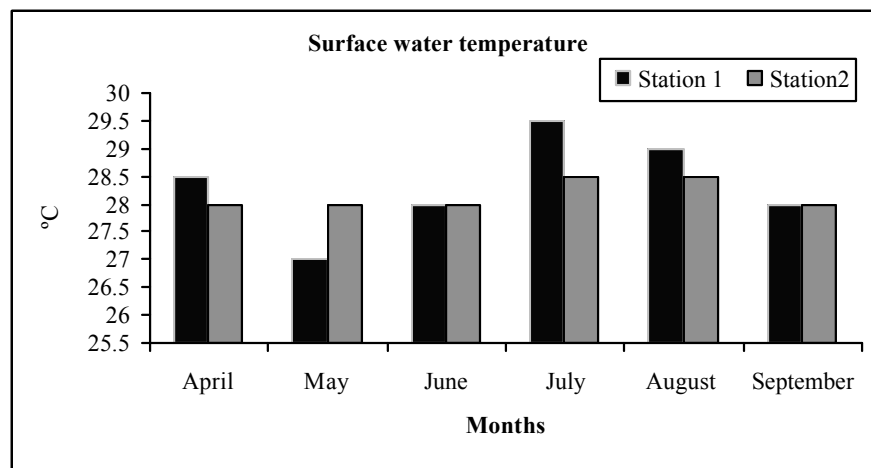


Fig. 4: Shows the Surface Temperature of Agnitheertham and Kothandaramar kovil

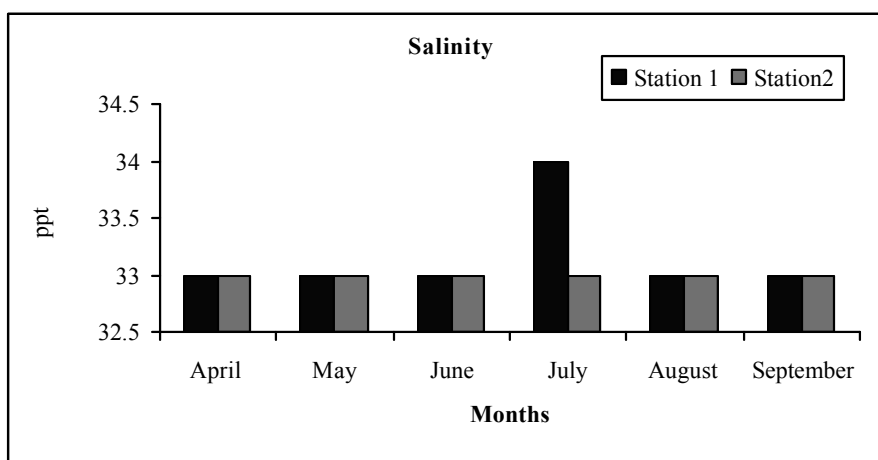


Fig.5. Shows the Salinity of Agnitheertham and Kothandaramar kovil

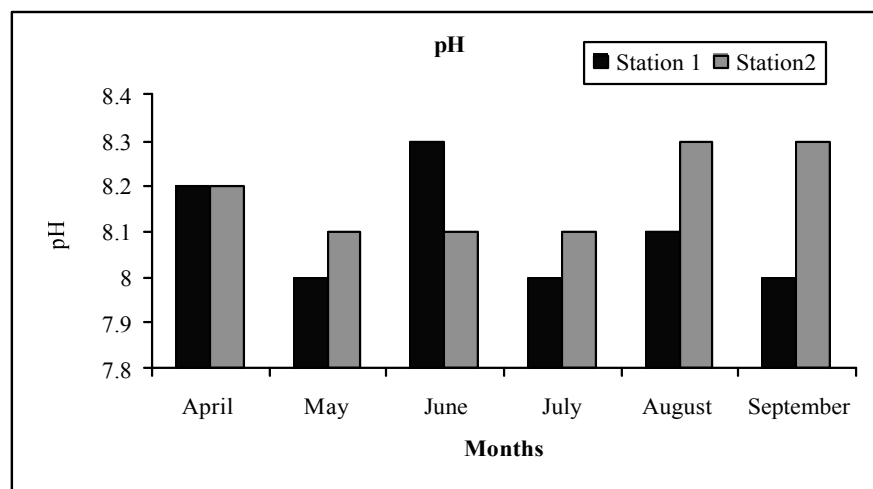


Fig.6. Shows the pH of Agnitheertham and Kothandaramar kovil

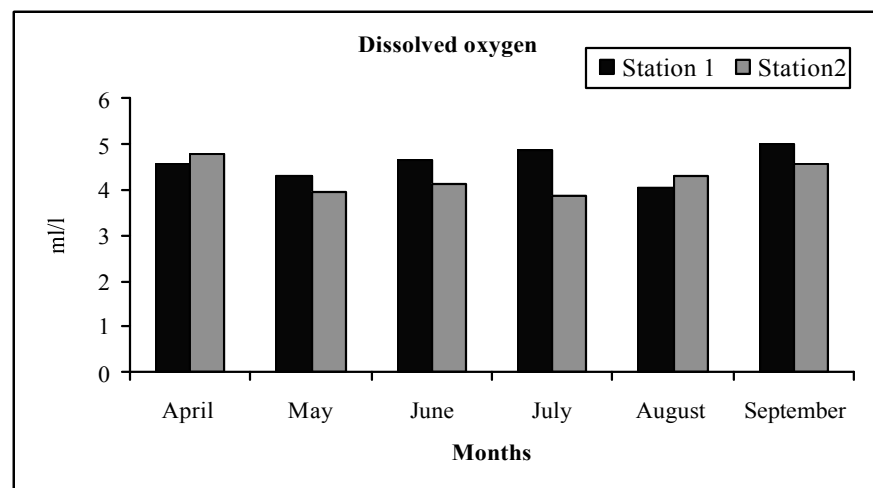


Fig.7. Shows the Dissolved Oxygen of Agnitheertham and Kothandaramar kovil

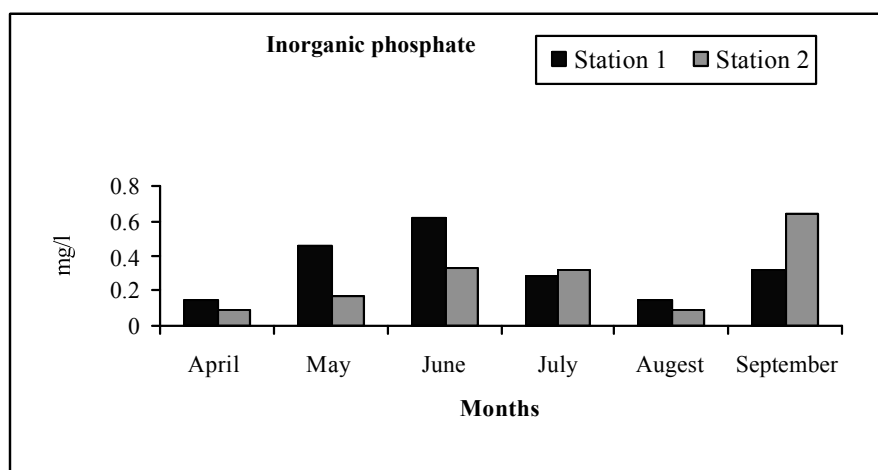


Fig.8. Shows the Inorganic Phosphate of Agnitheertham and Kothandaramar kovil

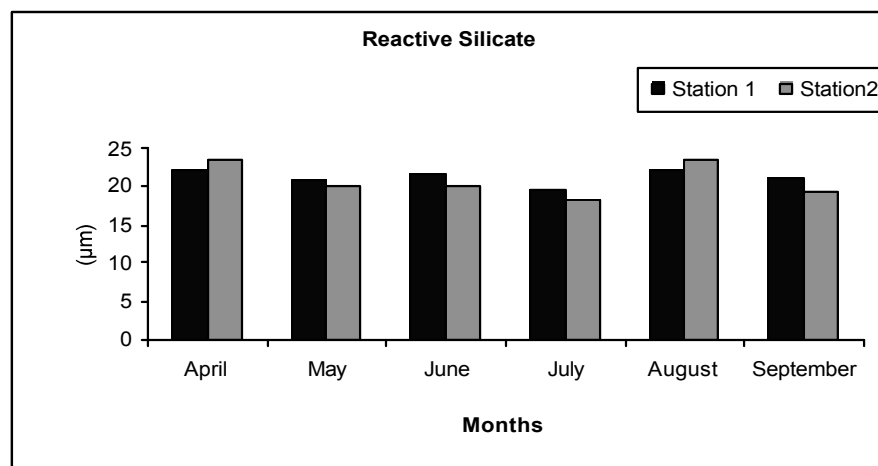


Fig.9. Shows the Reactive Silicate of Agnitheertham and Kothandaramar kovil

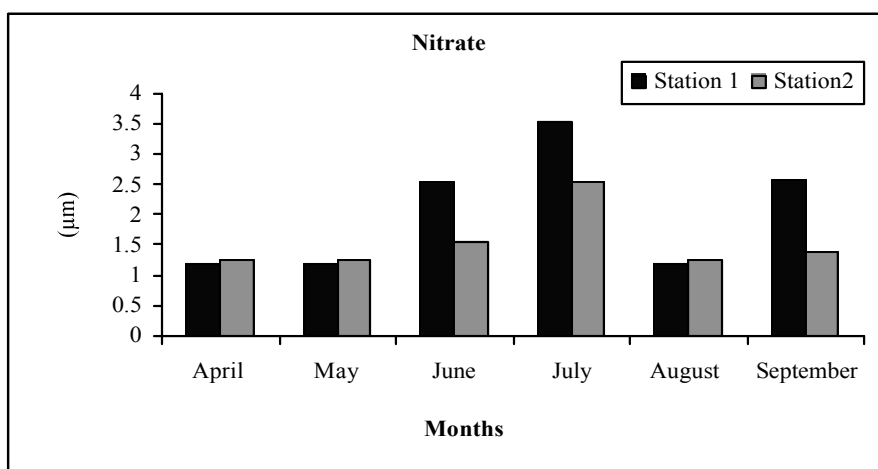


Fig.10. Shows the Nitrate of Agnitheertham and Kothandaramar kovil

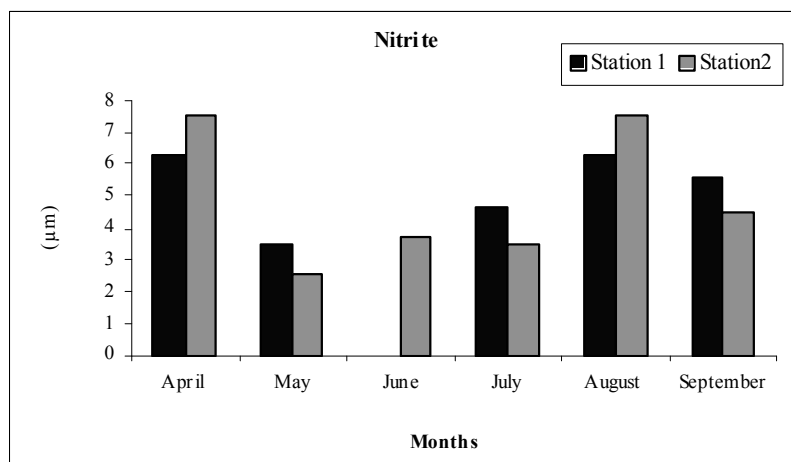


Fig. 11: Shows the Nitrite of Agnitheertham and Kothandaramar kovil

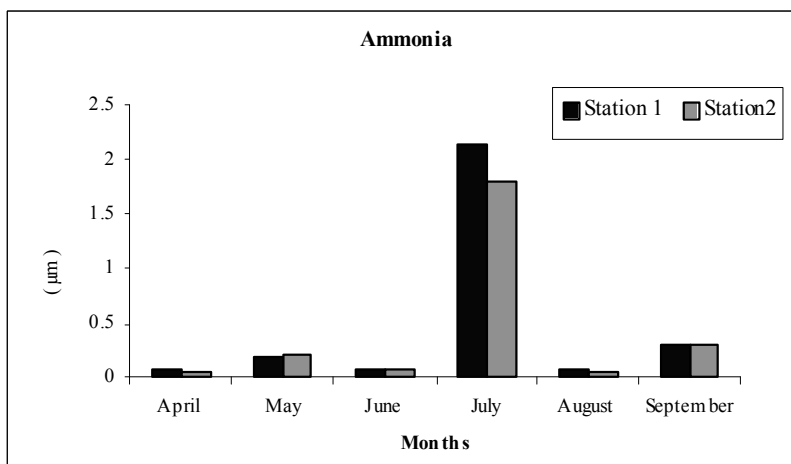


Fig. 12: Shows the Ammonia of Agnitheertham and Kothandaramar kovil

temperature, salinity, pH dissolved oxygen, inorganic phosphate, reactive silicate, nitrate, nitrite and ammonia were recorded for a period of six months from April 2007 to September 2007 was presented in Fig. (2-12).

The rainfall ranged from 6.0 mm to 29.9 mm. The maximum (29.9 mm) rainfall was during the month of April 2006 and the minimum (6.0 mm) was during the month of June. Total rainfall of the study area was 85.0 mm at both the stations. The atmospheric temperature ranges from 29.5 to 28.0°C at station 1 and 28.5 to 28.0°C at station 2. The maximum temperature (29.5 °C) was recorded during the month of May and July at station 1 and 2 and the minimum temperature was recorded during the month of June (28.0 °C) at station 1 and 2. The surface water temperature ranges between 29.0°C to 27.0 °C at station 1 and 28.0 to 27.0 at station 2. While the

maximum temperature was recorded during the month of July 2007 at station 1 and the minimum temperature was recorded during the month of June and September 2007 at station 2.

Salinity: The salinity (‰) ranges from 34 ppt-33 ppt at station 1 and 35 ppt-33 ppt at station 2. The maximum salinity was recorded during in the month of June at station 2 and minimum was during the month of April, August and September at station 1. The pH values ranges from were 8.3 to 8.0 and 8.3 to 8.1 respectively at station 1 and station 2. The maximum pH was recorded during the month of June at station 1 and August at station 2 and the minimum in the months of May, July and September at station 1 and May, June and July at station 2. The Dissolved oxygen (ml/l) concentration ranges from

Table 1: Simple correlation coefficient (r) values obtained between Physico-chemical, parameters during the month of April-2007 to Sep-2007 at station. 1

	Rain	Atm.Temp	Surface water temp.	Salinity	pH	DO	Nitrate	Nitrite	Ammonia	Inorganic phosphate	Reactive silicate
Rain	1										
Atm.Temp.	-.544	1									
Surface water temp.	-.787	.708	1								
Salinity	-.312	-.209	.243	1							
pH	-.031	.000	-.420	.000	1						
DO	-.068	.136	-.027	.122	-.151	1					
Nitrate	-.600	.423	.492	.430	-.161	.806	1				
Nitrite	.104	.530	-.026	-.928(**)	.134	-.091	-.263	1			
Ammonia	-.448	.609	.744	.433	-.463	.491	.770	-.215	1		
Inorganic phosphate	-.195	-.587	-.234	.746	.293	.186	.280	-.824(*)	-.119	1	
Reactive silicate	-.367	-.188	-.222	.440	.780	.100	.242	-.359	-.248	.774	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 2: Simple correlation coefficient (r) values obtained between Physico-chemical, parameters during the month of April-2007 to Sep-2007 at station. 2

	Rain	Atm.Temp	Surface water temp.	Salinity	pH	DO	Nitrate	Nitrite	Ammonia	Inorganic phosphate	Reactive silicate
Rain	1										
Atm.Temp.	-.329	1									
Surface water temp.	-.273	.816(*)	1								
Salinity	-.156	-.218	-.535	1							
pH	.055	-.186	.000	-.608	1						
DO	.564	-.704	-.346	-.363	.667	1					
Nitrate	-.575	.304	.372	-.103	-.484	-.604	1				
Nitrite	.168	-.181	.299	-.534	.684	.731	-.403	1			
Ammonia	-.434	.435	.481	-.316	-.384	-.579	.954(**)	-.387	1		
Inorganic phosphate	-.202	-.415	-.592	-.003	.186	.028	.235	-.438	.230	1	
Reactive silicate	.344	-.096	.234	-.243	.495	.635	-.662	.889(*)	-.652	-.689	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Analysis of variance (F-values) for the Physico-chemical parameters between station 1 and 2 during the month of April-2007 to Sep-2007

Parameters	Source of variance	SS	df	MS	F	F-crit
Atmospheric Temperature(°C)	Within	2.25	5	0.45	4.5	5.050329
	Between	0.75	1	0.75	7.5	6.607891
Water Temperature(°C)	Within	3	5	0.6	2.571429	5.050329
	Between	0.083333	1	0.083333	0.357143	6.607891
Salinity (‰)	Within	0.416667	5	0.083333	1	5.050329
	Between	0.083333	1	0.083333	1	6.607891
pH	Within	0.054167	5	0.010833	0.730337	5.050329
	Between	0.020833	1	0.020833	1.404494	6.607891
DO(mg/l)	Within	0.621542	5	0.124308	1.107243	5.050329
	Between	0.273008	1	0.273008	2.431748	6.607891
Nitrate(umol/l)	Within	5.161624	5	1.032325	5.552026	5.050329
	Between	0.752402	1	0.752402	4.046551	6.607891
Nitrite(umol/l)	Within	25.87098	5	5.174197	7.549049	5.050329
	Between	0.132826	1	0.132826	0.19379	6.607891
Ammonia(umol/l)	Within	5.687458	5	1.137492	117.4017	5.050329
	Between	0.01274	1	0.01274	1.314918	6.607891
IP(umol/l)	Within	0.248927	5	0.049785	1.827127	5.050329
	Between	0.010502	1	0.010502	0.385427	6.607891
Reactive silicate(umol/l)	Within	20093.51	5	4018.702	0.984236	5.050329
	Between	4136.69	1	4136.69	1.013133	6.607891

4.99 ml/l to 4.07 ml/l at station 1 and 4.77 to 3.87 at station 2. The maximum DO was recorded during the month of September at station 1 and April at station 2 and the minimum in the month August at station 1 and July at station 2.

The Inorganic nitrate concentration (μ) ranges from 0.62-0.15 at station 1 and 0.64 to 0.08 at station 2. The maximum nitrate concentration was recorded during the month of June at station 1 and September at station 2 and the minimum in the month of April and August at both the station. The reactive silicate (μ) content varied between 22.16-19.60 at station 1 and 23.58 to 18.11 at station 2. The maximum reactive silicate concentration was recorded during the month of April and August at both the stations and the minimum in the month of July at both the stations.

The Inorganic nitrate concentration (μ) ranges from 3.53-1.20 at station 1 and 2.52 to 1.25 at station 2. The maximum nitrate concentration was recorded during the month of July at both the stations and the minimum in the months of April, May and August at both the station. The Inorganic nitrate concentration (μ) ranges from 6.24-3.53 at station 1 and 7.52 to 2.52 at station 2. The maximum nitrite concentration was recorded during the month of April and August of both the stations and the minimum in the month of May at both the station. The ammonia concentration (μ) ranges from 2.15-0.08 at station 1 and 1.80 to 0.05 at station 2. The maximum ammonia concentration was recorded during the month of July at both the stations and the minimum in the month of April, June and August at station 1 and April and August at station 2.

DISCUSSION

The Gulf of Mannar and Rameshwaram areas known to receive rain fall from both north east and south west monsoon and hence this area experiences rain fall throughout the year reported by [4]. However, the northeast monsoon alone brings bulk of rainfall to this area than the south west monsoon. During the study period the total average annual rainfall recorded for the six months was 170 mm the maximum rainfall occurs in the month of April 2006 the minimum in the month of July during the pre monsoon season.

The seasonal minimum temperature at two stations was noticed during the month of June and the maximum during all the months. The range of temperature similar to the present study in the Gulf of Mannar Biosphere reserve was reported earlier by [5] and [6]. In other parts of the east coast of India especially Gopalpur coastal waters

by [7]. Gopinathan and Rodrigo (1991) recorded 27-34°C in the surface waters of Tuticorin and also a part of Gulf of Mannar. Ramamoorthy [6] recorded the atmospheric temperature ranged from 27-36°C. The spatial variation observed in temperature could be due to the variable intensity of prevailing currents and the consequent mixing of water [8].

In the present study salinity was minimum during the months of August and December due to mixing of fresh water through rain fall and precipitation. Salinity is the one of the important key factor in the marine environment. The fluctuations in salinity, affect the biological characteristics of the marine environment. Reid [9] remarked that the momentary salinity may be regarded a function of the quality and quantity of inflowing waters, rainfall and evaporation since these factors may vary with season (in some instances rather drastically)

Seasonal mean fluctuation in Hydrogen-ion (pH) concentration was very narrow (from 8.3 to 8.0) in the two stations, maximum pH was observed in the months June, July (summer season) similar pH in water, exhibiting a linear relationship with salinity was reported by [5] and from the Cheriapattu red reef waters by [6].

Dissolved oxygen concentration showed well marked seasonal variation at both the stations. In the present study, higher values of dissolved oxygen were recorded during the months of April, June and October due to phytoplankton photosynthesis which act as a major factor and higher solubility of oxygen in lower surface waters. Seasonal wise observation on dissolved oxygen showed an inverse trend against temperature and salinity, the similar findings were observed by [10] from Kodiakkarai coastal waters [11] from Pondicherry coast.

The Nitrate concentrations was higher during July which might due to the river runoff and input of fertilizers from the catchments areas possible way of nitrates entry is through oxidation of ammonia from nitrogen of nitrite formation. The similar findings were observed by [12] and [13] reported the low nitrate concentration during the summer season because utilization of phytoplankton.

The nitrite concentration was higher than the nitrate; it was higher during April which was due to seasonal floods, also increased phytoplankton excretion, oxidization of ammonia and bacterial decomposition of planktonic detritus to environment the similar findings were observed by [14].

The inorganic phosphate was found to be very high during the August and September due to the effect of excess land drainage which is increased the level of phosphate [18] the higher densities of phosphate

recorded from the Gulf of Mannar by [5] similar concentration of phosphate have been reported from the tropical reef waters.

The reactive silicate content was higher than nitrite, nitrate and inorganic phosphate. Seasonal variations in dissolved reactive silicate were apparent in the present study; higher concentration was recorded during the months of April, October and September. This could be attributed to the heavy influx of freshwater from land drainage, also the bottom sediment might have been exchanged with the overlying water due to the turbulent nature of water because of rain flow, similar observations made from Kodiakkarai coastal waters [10, 15], from Uppanar estuary, [16] from Vedaranyam coastal waters.

Higher concentration of ammonia was recorded during the month of July in both the stations, lower concentrations was recorded during the month of April at both the stations. The ammonia recorded higher concentration could be partially due to death and subsequent decomposition of phytoplankton and also due to the excretion of planktonic organisms. Similar results were also obtained by [17] from Mangalore coast.

REFERENCES

1. Padhi, M. and S. Padhi, 1999. Phytoplanktonic community of Gopalpur estuary. Seaweed Research and Utilisation Association, 21(1&2): 95-97.
2. Anon, 1987. The Gulf of Mannar biosphere project documents, Ministry of Environment and Forests, Govt. of India New Delhi, pp: 105.
3. Strickland, J.D.H. and T.R. Parsons, 1972. A Practical hand book of sea water analysis. Bulletin of Fish Resources, Canada, 167: 310.
4. Marichamy, R. and Pon Siraimetan, 1979. Hydrobiological studies in the coastal waters of Tuticorin, Gulf of Mannar. J. Marine Biol. Association of India, 21(1 and 2): 67-79.
5. Gopinathan, C.P. and J.X. Rodrigo, 1991. Investigations on primary production and related parameters in the inshore waters of Tuticorin. J. Marine Biological Association of India, 33(1&2): 33-39.
6. Ramamoorthy, K., 1998. Plankton characteristics of the coral reef environment of the Gulf of Mannar Biosphere Reserve, India. Ph.D., Thesis Annamalai University, pp: 49-50.
7. Rajashree Gouda and R.C. Panigrahy, 1993. Monthly variations of some hydrographic parameters in the Rushikulya estuary east coast of India Mahasgar Bulletin of National Institute of Oceanography, 26(2): 73-85.
8. Reddi, K.R., N. Jayaraju, I. Surya Kumar and K. Srinivas, 1993. Tidal fluctuations in relation to certain Physico-Chemical parameters in Swarnamukhi river estuary, East coast of India. Indian J. Marine Sciences, 22: 232-234.
9. Reid, G.K., 1967. Ecology of inland waters and estuaries. Reinhold publishing corporation, New York.
10. Anbazhagan, P., 1998. Hydrobiology and benthic ecology of Kodiakkarai coastal sanctuary (Southeast coast of India). Ph.D., Thesis, Annamalai University. India, pp: 208.
11. Ananthan, G., G.M. Ganesan, P. Sampathkumar, M. Mathevan Pillai and L. Kannan, 1992. Distribution of trace metals in water, sediment and plankton of the Vellar estuary. Seaweed Research and Utilisation Association, 15(1 and 2): 69-75.
12. Vasantha, K., 1989. Studies on hydrobiology and decomposition of macrophytes in Porto-Novo marine environment (South coast of India) Ph.D., Thesis Annamalai University, pp: 252.
13. Rajasekar, M., 2003. Physico chemical characteristic of the Vellar estuary in relation to shrimp farming. J. Environmental Biol., 24(1): 95-101.
14. Govindasamy, C., L. Kannan and Jayapaul Azaria, 2000. Seasonal variation in physico-chemical properties and primary production in the coastal water biotopes of Coramandal coast, India. J. Environ. Biol., 21(1): 1-7.
15. Murugan, A. and K. Ayyakkannu, 1991. Ecology of Uppanar backwaters, Cuddalore I. Physico chemical parameter. Mahasgar Bulletin of National Institute of Oceanography, 24(1): 31-38.
16. Azhagar, S., 2008. Plankton and Finfish larval resources of the Vedaranyam coastal waters (Southeast coast of India) with special reference to environmental parameters, M. Phil., Thesis, Annamalai University, pp: 21-21.
17. Sekar, K. and V. Hariharan, 1989. Seasonal distribution of nitrate, nitrite, ammonia and plankton in effluent discharge area of Mangalore, West coast of India. Indian J. Marine Sci., 18: 170-173.
18. Nair, N.B., P.K. Abdul Azis, M. Arunachalam, K. Krishnakumar and K. Dharmaraj, 1984. Ecology of Indian estuaries, Distribution of total phosphorous, total nitrogen and total pottassium in the sediments of Ashtamudi estury, Magasagar-Bulletin National Institute of Oceanography, 17(1): 33-39.