American Journal of Marine Science, 2014, Vol. 2, No. 2, 43-46
Available online at http://pubs.sciepub.com/marine/2/2/3

DOI:10.12691/marine-2-2-3

Water and Sediment Quality Assesment of Poonthura Backwater in the Southwest Coast of India

Leena Grace Beslin*

Department of Biotechnology, Vinayaka Missions University, Salem, India
*Corresponding author: drblgrace@rediffmail.com

Received October 13, 2014; Revised October 25, 2014; Accepted October 28, 2014

Abstract The fate and effect of different pollutants entering into the estuaries can be obtained from the existing physico-chemical parameters and it is worthwhile to acquire the hydrographical features of the estuaries at different seasons. This determines the tropic dynamics of the water body. The present study has been made to detail the hydro-geo dynamics of Poonthura estuary. Sewage and retting materials were the main sources of Poonthura estuary. The physico-chemical parameters analyzed include temperature, pH, salinity and alkalinity and dissolved oxygen. The toxic gases hydrogen sulphide, ammonia nitrogen and nutrients viz. nitrite-nitrogen, phosphate phosphorous and silicate-silicon of water samples and the sediment parameters viz. organic carbon, total nitrogen, total phosphorus. From the present study the parameters which are unsuitable for the healthy environment increases during premonsoon due to concentration of pollutants. The winter season showed fewer nutrients with normal level of dissolved oxygen.

Keywords: *backwater, Poonthura, sediment, nutrients and pollution*

Cite This Article: Leena Grace Beslin, “Water and Sediment Quality Assesment of Poonthura Backwater in the Southwest Coast of India.” *American Journal of Marine Science*, vol. 2, no. 2 (2014): 43-46. doi: 10.12691/marine-2-2-3.

1. Introduction

Estuaries are physico chemically unique as they show strong variations in salinity, temperature, pH, dissolved oxygen, redox potential and the amount and composition of particles (Chapman and Wang Feiyue, 2001).They represent the outfall regions of river and represent transitions between fluvial and marine environment, where tidal actions favours the mixing of freshwater and saltwater. The rate of mixing depends upon channel geometry, the relative amount of freshwater and tidal inflow, wind and the difference in densities of two types of waters (Mishra *et al*., 2008). The physical parameters evaluate the changes due to addition of potential pollutants. These parameters are the limiting factors for the survival of aquatic organism (flora and fauna). Poor water quality may be caused by low water flow, municipal effluents and industrial discharges (Lawson, 2011).

Among various abiotic factors salinity, temperature and pH are considered as most important since the variations definitely pose a threat to biota (Menon *et al.,* 2000). The fate and effect of different pollutants entering into the estuaries can be obtained from the existing relationship with salinity and other physico-chemical parameters. So it is worthwhile to acquire the hydrographical features of the estuaries at different seasons as it determines the tropic dynamics of the water body. A great deal of pollution comes from domestic, agricultural or industrial wastes and can be totally toxic which demolish the fish species. In such condition some species are favoured but most others are greatly affected and it alters the environment. Thus the human activity increases the instability of indigenous fishes. This creates various new and intense stresses leading to decline in species in countless numbers (Behera *et al.2014*).

Poonthura backwater system of Kerala serves as areas for coconut husk retting. The production of coir fibre caused large scale organic pollution with the mass destruction of flora and fauna converting sizeable sections of backwater into virtual cesspools of foul smelling stagnant waters. The partially treated sewage and the completely untreated industrial effluents are the main sources of pollution. The exponential interference of human activities and industrialization has brought in undesirable enrichment of nutrients and heavy metals in the aquatic environment. Even though many studies have been undertaken to elucidate the hydrography of estuaries, the increasing threat to the bioresources in recent years forced to evaluate the water and sediment parameters of Poonthura estuary.

1.1. Study Site

The Poonthura backwater is situated about 5.6 km south of the international airport at Thiruvananthapuram (latitude between 8°25’ and 8°3’N and longitude 76°55’ and 77°00’E). It is a typical estuary, circular in shape and enclosing an island called Edayar. The total length of the estuary is 4.35 km and the mean width is 0.1 km. This is separated from the Lakshadweep Sea by a sand bar at

Poonthura which opens during the monsoon period following heavy discharge of water from the Karamana river. The Parvathyputhanar canal through which the sewage spilled from the sewage farm situated at Muttathara, reaches the Poonthura estuary.

2. Material and Methods

2.1. Collection of Samples

Water samples for a period of one year from April 2011 to March 2012 were collected. Sampling was done during morning hours between 6 AM and 10 AM. Surface water samples were collected using a clean plastic bucket and the bottom water with a van-dorn bottom water sampler at a depth of one meter from the surface. The collected water samples were transferred to the pre-cleaned, polythene bottles and stored in the refrigerator. The water for the estimation of dissolved oxygen was fixed in the field itself and the samples used for the analysis were filtered by Millipore filtering unit through Whatman GF/C filter paper of 0.5µ porosity.

2.2. Physico – Chemical Analysis of Water Samples

Temperature of surface and bottom water was recorded in the site itself using a high quality Celsius thermometer. The hydrogen ion concentration (pH) of water sample was measured in the laboratory using Elico-model L_1 – 10 pH meter. The Mohr-Knudsen titration method using potassium chromate indicator was followed to measure the salinity (Grasshoff, 1983).The alkalinity of the sample was estimated by back titration method of Gripenberg modified by Trivedy and Goel (1986). Dissolved oxygen was determined by classic Winkler's titration method (Grasshoff, 1983).

The determination of hydrogen sulphide by Lauth's violet method equalent to methylene blue method was followed (Grasshoff *et al.*, 1983). Estimation of ammonia was made by the Colorimetric method of steam distillation by microkjeldahl, distillation unit (Trivedy and Goel, 1986). The Photometric determination of nitrite was followed to estimate the nitrite nitrogen (Grasshoff *et al.*, 1983).The estimation of inorganic phosphate in the water was made by following the modified method of Murphy and Riley (Grasshoff *et al.*, 1983). Silicate silicon was estimated by adopting the method of Koroleff (1983) and the optical densities were noted spectophotometrically.

2.3. Analysis of Sediments

The total organic carbon from sediment samples were estimated by the Walkley and Black method modified by Trivedy and Goel (1986).Total phosphorous by modified method of Murphy and Riley and the total nitrogen content was determined by microkjeldahl method (Grasshoff *et al.*, 1983). Heavy metals of the sediment were measured by the method of Danielsson et al. (1982) using atomic absorption spectrophotometer (GBC 932 AA).

3. Results

The results of the physico-chemical features of the Poonthura estuary are presented in Table 1. The temperature distribution of the Poonthura estuary ranged from 28.3°C in June to 31.2°C in May. The range of pH was between 7.28 in March and 8.14 in May. The salinity distribution ranged from 1.05 ppt in January to 13.46 ppt in November. Alkalinity range was between 12 ppt in November and 114 ppt in October. The dissolved oxygen content varies from 1.31 mg/l in January to 5.98 mg/l in July. The hydrogen sulphide content ranged from 0.04 mg/l in September to 1.49 mg/l in May. The Ammonia nitrogen of the estuary ranged from 0.11 in September to 0.89 mg/l in July. Nitrite nitrogen was between 0.02 mg/l in August and 1.02 mg/l in May. The phosphate content of the estuary was from 0.21 in December to 1.01 mg/l in March. The silicate distribution ranged between 0.16 mg/l in November and 3.91 mg/l in May (Table 2).

Table 1. Station wise mean distribution of physico-chemical parameters in Poonthura backwater

Months	Temperature (°C)	PH	Salinity (ppt)	Alkalinity (ppt)	DO (mg/l)
Apr	30.90	7.67	2.91	102.00	4.37
May	31.20	8.14	2.41	113.33	3.72
Jun	28.30	7.84	5.66	49.67	5.38
Jul	30.00	7.67	6.78	60.00	5.98
Aug	28.80	7.72	2.10	84.33	4.81
Sep	29.30	7.53	0.87	94.67	3.58
Oct	30.00	7.37	0.84	114.00	1.92
Nov	29.50	7.32	13.46	12.00	2.15
Dec	29.40	7.42	7.41	70.33	1.75
Jan	30.80	7.60	1.05	105.00	1.31
Feb	30.90	7.44	2.20	98.33	2.25
Mar	32.3	7.28	3.57	94.33	3.13

Table 2. Station wise mean distribution of toxic gases and nutrients in Poonthura backwater (mg/l)

Months	Hydrogen Sulphide	Ammonia Nitrogen	Nitrite Nitrogen	Phosphate Phosphorus	Silicate Silicon
Apr	1.16	0.42	0.43	0.61	2.06
May	1.49	0.27	1.02	0.52	3.91
Jun	0.95	0.51	0.13	0.41	1.25
Jul	0.40	0.89	0.14	0.32	0.64
Aug	0.21	0.13	0.02	0.30	3.53
Sep	0.04	0.11	0.02	0.28	0.54
Oct	0.14	0.12	0.02	0.87	1.15
Nov	0.06	0.21	0.17	0.64	0.16
Dec	0.36	0.30	0.30	0.21	0.42
Jan	0.65	0.38	0.37	0.26	0.55
Feb	0.82	0.53	0.31	0.74	0.58
Mar	1.07	0.60	0.31	1.01	0.60

Table 3. Station wise mean distribution of sediment parameters in Poonthura backwater

Months	Organic Carbon(mg/g)	Total Nitrogen (mg/g)	Total Phosphorus (mg/g)
Apr	12.76	0.82	8.59
May	13.34	0.35	9.28
Jun	5.98	0.37	7.83
Jul	6.11	0.35	6.06
Aug	6.67	1.03	5.06
Sep	16.88	0.58	3.41
Oct	31.37	0.54	2.13
Nov	13.01	0.70	2.98
Dec	14.38	0.72	4.73
Jan	16.56	0.79	9.32
Feb	14.84	0.70	9.79
Mar	14.95	0.68	10.21

The sediment parameters are presented in Table 3. The organic carbon content was between 5.98 mg/g in June to 3`1.37 mg/g in October. The total nitrogen content varied from 0.35 mg/g in May to 1.03 mg/g in August. Total phosphorous was between the range of 2.13 mg/g in October and 10.21 mg/g in March. The mean values of these parameters were interpreted in the Table 4 and Table 5.

Table 4. Monthly mean distributions of hydrological parameters in Poonthura backwater

parameters	Station-I		Station-II		Station-III		mean
	Surface	Bottom	Surface	Bottom	surface	Bottom	
Temperature(°C)	30.50±1.51	30.20±1.26	30.00±1.42	29.80±1.32	30.40±1.37	29.90±1.32	30.13± 0.28
pH	7.66 ± 0.38	7.50 ± 0.32	7.78 ± 0.19	7.63 ± 0.17	7.50 ± 0.28	7.42 ± 0.34	7.58± 0.13
Salinity (ppt)	3.37 ± 4.31	3.74±4.38	4.42 ± 3.47	4.51 ± 3.89	4.53 ± 3.96	4.06 ± 3.86	4.11± 0.47
Alkalinity(ppt)	83.17 ± 4.35	92.83 ± 4.20	64.17 ± 5.32	69.83 ± 4.01	93.67 ± 7.11	95.83 ± 2.67	83.25± 7.37
DO (mg/l)	5.12± 3.46	5 ± 3.35	1.67 ± 1. 53	1.14 ± 0.63	5.38 ± 3.56	5.38 ± 3.38	3.95± 1.98
HS(mg/l)	0.58 ± 0.49	0.58 ± 0.48	0.98 ± 1.08	0.8 ± 0.76	0.38 ± 0.32	0.36 ± 0.31	0.61± 0.24
Ammonia (mg/l)	0.41 ± 0.43	0.32 ± 0.52	0.42 ± 0.14	0.37 ± 0.13	0.39 ± 0.17	0.32 ± 0.18	0.37 ± 0.04
Nitrite (mg/l)	0.24 ± 0.21	0.22 ± 0.17	0.33 ± 0.40	0.39 ± 0.63	0.22 ± 0.16	0.22 ± 0.16	0.27 ± 0.07
Phosphate (mg/l)	0.34 ± 0.27	0.32 ± 0.26	0.78 ± 0.43	0.75 ± 0.43	0.33 ± 0.35	0.26 ± 0.28	0.47 ± 0.24
Silicate (mg/l)	1.34 ± 1.17	1.38 ± 1.17	1.38 ± 1.54	1.30 ± 1.39	1.26 ± 1.27	1.04 ± 1.09	1.28 ± 0.12

Table 5. Monthly mean distributions of CNP contents in Poonthura backwater (mg/l)

parameters	Station-I	Station-II	Station-III	Mean
Organic carbon	10.61 ± 1.40	22.73 ± 1.24	8.36 ± 1.77	13.90 ± 7.73
Total nitrogen	0.64 ± 0.27	0.59 ± 0.19	0.68 ± 0.23	0.64 ± 0.05
Total phosphorus	6.19 ± 1.61	7.96 ± 1.29	5.7 ± 0.91	6.61 ± 1.19

4. Discussion

The fall in water temperature in monsoon may be due to the fewer incidences of radiation, heavy freshwater discharge and precipitation. The rise in temperature noticed in premonsoon was due to the influence of hot climatic conditions and concentration of more pollutants. Similar situations of high temperature during premonsoon and low temperature during monsoon months have been reported by Chahuan and Ramanathan (2008). Temperature variations noticed between the stations may possibly be due to the state of pollutants and the geomorphology of the estuary. The pH varies according to the level of mixing of sea water with the fresh water. The high values at the marine zone were due to the coagulation of colloidal particles which shifts the pH towards the alkaline side (Arockia Gaspar and Lakshman, 2014).During post monsoon, comparatively higher pH values were observed due to the mixing of sea water and biological activity (Satheeshkumar and Anisa Khan, 2009). The mean pH was towards acidic and this was due to the discharge of acid effluents from the Travancore titanium industries (Saravanakumar *et al.*, 2008). The oscillation of pH towards the acidic phase or near to neutrality at all stations during the monsoon could be attributed to heavy river discharge and land run off.

Salinity, the most fluctuating parameter in the estuary depends on the topography, state of tide, time of the year, intensity of rainfall and the extent of fresh water flow. Behera *et al.*, (2014) reported that salinity of an estuary is being controlled diurnally by the entry of sea and freshwater from both sides and variations in salinity may be controlled by the nature of connection of the estuary. Surface salinity within the estuary was observed to be lower than that of the bottom in most of the months due to the density of ions that sink to the bottom leads to salinity stratification. Soundarapandian *et al.*, 2009 reported that the freshwater could no longer fill up the whole basin of the backwater from surface to the bottom and it was only limited to the surface layer. The near bottom counter current of the sea water leads to the intrusion of sea water in the deeper channels and the salinity increased continuously with the depth. The increased salinity during pre monsoon could be attributed to increased temperature and wind ensuing greater evaporation.The intrusion of sea water controlled the freshwater flow from the link canals during monsoon season with high salinity and the post monsoon with less salinity gradients (Reddy and Hariharan, 1985).

The high values of alkalinity may recognize the dissolution of calcium carbonate from the sediments. Like salinity, alkalinity also exhibited high values in bottom and in the bar mouth region. Prasanna and Ranjan (2010) reported that alkalinity in natural waters was due to the presence of free hydroxyl ions and hydrolysis of salts formed by weak acids and strong bases such as carbonates and bicarbonates. Padma and Periakali (1999) reported that increase in alkalinity during post monsoon period was due to the input of freshwater and dissolution of calcium carbonate and bicarbonate ions in the water column. The higher surface DO levels in all the stations in most of the months suggest that the surface water tends to attain saturation levels of oxygen because of the direct diffusion of atmospheric oxygen and super saturation or depletion of oxygen which may be due to the result of photosynthetic and respiratory activities of marine organisms. The combined effects of winter cooling and high photosynthetic activity lead to the increase of DO during monsoon (Padmavathi and Satyanarayana, 1999). The reduction of oxygen level during pre monsoon months was mainly due to the addition of deoxygenated water from the retting grounds. Khalil and Nida (2014) linked the gradual decrease in oxygen concentration or anoxic condition to the high concentration of hydrogen sulphide. Irregular pattern of distribution of ammonia regarding different season may be due to excretion by organisms. Organic accumulants and oxidation of ammonia by bacterial, photochemical or by phytoplankton may cause raise in ammonia. Lawrence (2010) attributed the irregular pattern of seasonal distribution of nitrite in different stations may be due to the oxidation of ammonia or reduction of nitrate in the estuarine environment. Relatively high removal of phosphate in monsoon due to the combined effects of desorption from suspended particulates and its greater utilization by phytoplankton.

Estuarine sediment is richer in organic matter than those of adjacent sea. Maximum percentage of organic carbon is noticed in post monsoon and pre monsoon periods which may be due to the organic production which favoured vegetation and rain water run off (Saravanakumar *et al*., 2008). The irregular pattern of sediment nitrogen is due to the movement of sediment particles by mixing process and river discharges. The total phosphorous and organic matter in sediments increased in winter when river flow was high and decreased in pre monsoon (Mc Comb *et al.*, 1998).The present report and the Water Quality Index suggests that the water quality is not suitable for recreational purposes without taking any corrective steps and is only fit for other purposes like non sensitive pesiculture, livestock drinking and irrigation. Generally, once a trend in pollution sets in, it speed up day by day. So, there is a possible risk of water and sediment quality deterioration in near future (Ami and Arvind, 2014).

References

[1] Ami G. and Arvind S. 2014. Water Quality Index of Mahi River, Vadodara, Gujarat. *International Journal of Engineering Development and Research*, 2(3): 3214-19.

[2] Arockia Gaspar D.T.and Lakshman G. 2014. Water Quality Parameters of Thamirabarani Estuary. *International Journal of Advanced Research*, 2(4): 380-386.

[3] Behera B.C., Mishra R.R., Patra J.K., Dutta S.K. and Thatoi H.N. 2014. Physico Chemical Properties of Water Sample Collected From Mangrove Ecosystem of Mahanadi River Delta, Odisha, India *American Journal of Marine Science, 2(1): 19-24.*

[4] Chahuan R. and Ramanathan A.L. 2008. Evaluation of water quality of Bhitarakaika mangrove ecosystem, Orissa, East coast of India. *Indian Journal of Marine Science*, 37: 153-158.

[5] Chapman P.M and Wang Feiyue, 2001. Assessing sediment contamination in estuaries. *Environ. Toxicol. Chem.*, 20(1): 3-22.

[6] Grasshoff K., Ehrhardt M. and Kremling K. 1983. Methods of sea water analysis; II edition, Verlag. Chemie. 419pp.

[7] Khalil S. and Nida A. 2014. An efficient method for assessing water Quality based on bayesian belief networks. *International Journal on Soft Computing*, 5(2): 21-32.

[8] Lawrence B. 2010. Eutrophication status of Thamirabarani River at Kuzhithurai, *Journal of Basic and Applied Science,* 4(3): 168-173.

[9] Lawson E.O. 2011. Physico-chemical parameters and heavy metal contents of water from the mangroves swamps of logos lagoon, logos, Nigeria, *Advances in biological research*, 5(1)08-21.

[10] Mc Comb A.J. Qiu S., Lukatelieh R.J. and Auliffe T.F. 1995. Spatial and temporal heterogeneity of sediment phosphorus in the peel Harvey estuarine system. *Estuar Coast Shelf Sci.*, 47 (5): 561-577.

[11] Menon N.N. Balchand A.N. and Menon N. R. 2000. Hydrobiology of the Cochin backwater system – a review. *Hydrobiologia*, 430(1-3): 149-183.

[12] Mishra R.R. Rath B. and Thatoi H.N., 2008. Water quality assessment of aquaculture ponds located in Bhitarakanika mangrove ecosystem, Orissa, India. *Turkish Journal of Fisheries and Aquatic Science,* 8: 71-77.

[13] Padma S. and Periakali, 1999. Physico-chemical and geochemical studies in Pulicat lake, east coast of India. *Indian J. Mar. Sci*., 28: 434-437.

[14] Padmavathi D. and Satyanarayana D. 1999. Distribution of nutrients and major elements in river line, estuarine and adjoining coastal waters of Godavari, Bay of Bengal. *Indian J. Mar. Sci.*, 28: 345-354.

[15] Prasanna and Ranjan, 2010. Physico Chemical Properties of Water collected from Dhamra Estuary, *International Journal of Environmental Science*, 1(3): 334-341.

[16] Reddy H.R.V. and Hariharan V. 1985. Physico-chemical parameters of Netravathi-Gurupur Estuary, Mangalore. *Environ. Ecol*., 3(4): 530-534.

[17] Saravanakumar A. Rajkumar M. Sesh Serebiah J. and Thivakaran G.A. 2008. Seasonal variation in physicochemical characteristics of water, sediment and soil texture in arid zone mangroves of Kachchh-Gujarat. *Journal of Environmental Biology,* 29 (5): 725-732.

[18] Satheeshkumar P. and Anisa Khan B. 2009. Seasonal Variation of Physico Chemical Parameters of water and Sediment characteristic of Pondicherry Mangroves. *African Journal of Basic And applied Science,* 1(1-2): 36-43.

[19] Soundarapandian P. Premkumar T. and Dinakaran G.K. 2009. Studies on the Physico- chemical Characteristic and Nutrients in the Uppanar Estuary of Cuddalore, South East Coast of India. *Curr. Res. J. Biol. Sci.,* 1(3): 102-105.

[20] Trivedy P.K. and Goel P.K. 1986. Chemical and biological methods for water pollution studies, Series in Methodology, Environmental Publications, Karad, 220pp.