ISSN 2321–340X

Journal of Aquatic Biology & Fisheries | Vol. 7 | 2019 | pp. 83 - 88

NUTRIENT DISTRIBUTION AND PHYTOPLANKTON PRODUCTIVITY OF KAPPIL BACKWATERS, SOUTHWEST COAST OF INDIA

Praveena, M.*and Santhosh, S.

P. G. and Research Department of Zoology,
N. S. S. College, Pandalam, Kerala
**Email: mkspraveena@gmail.com*

Abstract: Nutrient parameters such as NO_2, NO_3, PO_4, SiO_4 and phytoplankton productivity of KappilKayalon thesouthwestcoast of India was monitored over a period of one year (June 2015 to May 2016). Spatial variations in nutrient loading and primary productivity were noticed between months. Monsoon season was found rich with nutrients and highly productive in all sampling stations. Among the six sampling stations, four stations were recorded higher phytoplankton productivity during the period of study. Maximum value of GPP (497.25 mgC/m^3/hr) and NPP (444.75 mgC/m^3/hr) was recorded during October 2015 and minimum values (GPP 102.08 mgC/m^3/hr ; NPP 25.83 mgC/m^3/hr) were recorded during April 2016.

Key words: Nutrients, Phytoplankton Productivity, Kappil

INTRODUCTION

Estuaries are dynamic ecotones providing habitat for both freshwater and marine organisms. As these zones are rich in nutrients, estuaries are highly productive and act as a feeding ground for many aquatic organisms. Estuaries are unique spot of biodiversity. They are habitually depicted as having low salinities, shallow depths, high turbidity, enough nutrients and rich in productivity (Feebarani, 2009). Estuaries rich in biodiversity are often utilized for fishing, aqua culture, recreation, transportation and tourism. Studying about the hydrological and ecological features of the estuaries are very important as these zones are blessed with nutrients and are the most productive ecosystems in the planet. Water bodies like ponds, rivers, rivulets, estuaries and oceans serves habitat for variousaquatic organisms(Ramachandra and Malavika 2007). India is bestowed with a large network of water bodies linking the inland fresh water system, the rivers with the estuaries and coastal seas. In India there are 113 major and minor estuaries which are connected to a combined river length of 45,000 km. (Ramesh and Purvaja, 2009).

Primary productivity is an important factor in assessing the fertility of a water body (Feebarani, 2009) and is well depends on the availed nutrients. Usually estuarine environments are enriched with nutrients through many sources. Bemer and Bemer (1987) well documented a number of nutrient sources for phytoplankton in the surface water. Nutrients are essential for the growth and wellbeing of primary and secondary producers in an estuary (Nair, 1995). The production capacity of an aquatic ecosystem can be monitored by assessing the Gross Primary Productivity (GPP) and Net Primary Productivity (NPP). Surface water contains a rich variety of micro organisms. Phytoplanktons are photosynthesizing microscopic organisms and they are treated as the primary production agents of an aquatic ecosystem. It also treated as a nutrition element which determines the primary productivity. Nutrients are bio stimulants and are utilized by photosynthetic organisms to generate organic matter. The growth and development of phytoplaktons are depends on the availability of such nutrients (Haridevi, 2013). This paper documents nutrient distribution and phytoplankton productivity of Kappil backwaters, southwest coast of India.

MATERIALS AND METHODS

ParavurThekkekayal, also known as Kappilkayal, is a shallow brackish water system (8°77'75.90" - 8°78'88.13"N ; 76°67'58.48" - 76°67'68.83"E) and part ofKappil backwater system of Thiruvananthapuram district, Kerala, India. The main fresh water inflows of this back water system is a small river called AyiroorPuzha (Ayiroor River). Unlike the other larger river systems of Kerala, the 17 km. long AyiroorPuzha originates at Navayikulam, a midland part of Kerala and flows in to the VarkalaHariharapuramKayal. Ithikkara River, originatingfrom the Western Ghats and flows down to the ParavurKayaland contribute towards the ecology of Kappil backwaters. A natural 'pozhi' (bar mouth) can be seen here, which connects Kappil Backwaters to the Arabian Sea. But during summer months a sand bar is formed in between the lake and sea. This backwater is often used for fishing, retting, recreation and aquaculture.

Before the study was started, detailed investigation was made on the study area (Figure 1) and according to the geographical and ecological peculiarities six stations were fixed for sample collection: I. Kappilpozhi, II. Kappil bridge, III. Kilimukkamkayal, IV. Maniyamkulam canal mouth, V. EdavaNadayarakayal and VI.Kottamoola. Monthly water samples were collected from six stations between June 2015 to May 2016. Samples were analysed for measuring both nutrients and phytoplankton productivity. All the analyses were carried out following standard methods (APHA, 2012).

Fig. 1. Location Map of Kappil backwater system, Kerala, showing study stations

RESULTS AND DISCUSSION

Nutrients

Seasonal mean distribution of nitrite is presented in Fig.2. The distribution of nitrite in water samples of Kappil backwaters ranged from 0.41mg/l to 1.02 mg/l. The highest value was recorded in station IV during June 2015 and lowest in station I during December 2015. Highest monthly mean value of nitrite was also recordedin June 2015 (0.92 mg/l) and lowest in both in August 2015 and January 2016 (0.60 mg/l). Highest annual mean value was got from station IV (0.84 mg/l) and lowest was recorded at station III (0.70 mg/l). Highest concentration of nutrients in estuarine water during monsoon season was also reported by Bhat (2003) in Aghanasini estuary, Kumta.Maximum seasonal mean value of nitrite was recorded in station IV (0.91 mg/l)during monsoon season and minimum value was obtained from station III (0.64 mg/l) during pre-monsoon season. The average annual and monthly mean value of nitrite was recorded below 1 mg/l during the study period.Concentration of nitrite in Kappilkayalwas found high during monsoonmonths and trends to lower levels towards reaching summer months and it may be due to the lack of nutrient rich fresh water inflow and intake by planktons. Similardistribution pattern was noticed in Thengapattanam estuary by Anitha (2014). Higher nitrite values in monsoon season and lower values in summer monthswere also reported by Karuppiahet al. (2011), Prabuet al.(2008) and Manikannan et al. (2011).An interesting fact in the distribution of nitrite in the present study was a marginal hike in station VI during summer months. It might be due to the retting process here in this station. ANOVA of nitrite values showed significant variation between months at 1% level ($P<0.000$). Nitrite was found positively correlated to nitrate ($r=0.752$), phosphate ($r= 0.633$) and silicate ($r=0.556$) (Table 1).

Seasonal mean distribution of nitrate in Kappil backwaters was found maximum in station IV (4.70 mg/l) and minimum in station II and III (2.24 mg/l). Both minimum and maximum values were recorded during pre-monsoon month and are presented in Fig.3.

Generally nitrate content in the water samples of Kappilkayalranged between 1.02 mg/l to 5.02 mg/l. Maximum value was recorded in station IV during May 2016 and minimum value was recorded in station III during December 2015. Highest annual mean value was also recorded at station IV (4.27 mg/l) and lowest was at station III (2.60 mg/l). Likewise the distribution of nitrites, nitrate values also showed hike in rainy months. Highest monthly mean value of nitrate was found during June 2015 (4.28 mg/l) and lowest during December 2015 (2.16 mg/l). Monsoon months recorded higher values compared with summer months. This means that the backwater gets heavy nitrate concentration mainly from the inflows. Water discharge from agriculture land such as paddy field, coconut plantation etc. may also also contribute to the higher nitrate values. Maximum nitrate values during monsoon and minimum values during pre-monsoon were reported by Soundarapandian et al.(2009) in Uppanar Estuary, Cuddalore. Similar conditions were also reported by Haridevi (2013) and Martin et al(2008) from Cochin backwaters. Domestic sewages and organic pollutants also have an effect on nitrate values. Station IV is a canal mouth which connects KappilKayal to ParavurKayal is a dumping yard of various organic and inorganic waste materials. Decomposition of such organic waste materials resulted to the higher nitrate values. Formation of nitrate through decomposition of organic waste materials was reported in Pennar estuary by Ravaniah et al. (2010). ANOVA of nitrate values showed that variations were significant at 1% level between months ($P<0.001$), and stations ($P<0.000$). Nitrate values are positively correlated to nitrite ($r=0.752$), phosphate ($r=0.583$), silicate ($r=0.458$) and GPP($r=0.305$).

The observed variation in the distribution of phosphate was ranged from 0.62 mg/l to 1.27 mg/l. Maximum value was observed at station VI during May 2016 and minimum value was found at station V during both in August and December 2015.

Highest monthly mean value of phosphate was recorded in June 2015(1.10 mg/l) and lowest value was found during December 2015 (0.74 mg/l). Highest average annual mean value of phosphate was found in station IV and VI (1.01 mg/l)and lowest was recorded in station V (0.82 mg/l). Annual average mean value of phosphate was found more or less similar in all stations. However slightly higher concentration of phosphate values were recorded at station IV and VI. Maximum values were found during pre-monsoon period at station I, II, III,IV and VI. But maximum values in station Vwere gained during monsoon season. Maximum seasonal average value of phosphate was gained from S VI (1.22 mg/l) and minimum value was gained from S III (0.74 mg/l) during post-monsoon and S VI (0.74 mg/l) during pre-monsoon season (Fig. 4). In all stations phosphate values showed an increasing tendency by the end of post-monsoon season. Increasing tendency of phosphate values during summer months may be due to the exchange of phosphorous between sediments and overlaying water. The low consumption of planktons and precipitating condition also contributes higher phosphate values during summer season. Such a condition was previouslynoticed in the current study area by Madhukumar (1996).Analysis of variance showed that phosphate values are significantly varied between months ($P<0.001$) and s ($P<0.001$). Phosphate values were found positively correlated to nitrite ($r=0.633$), nitrate ($r=0.583$) and silicate ($r=0.266$) (Table 1).

Seasonal mean distribution of silicate in Kappilkayalis presented in Figure 5 and it showed that maximum values were recorded during monsoon period in all stations. Highest concentration of silicate was measured at station IV (2.21mg/l) during June 2015 and lowest was measured at station III (0.85 mg/l) during August 2015. Monthly mean value was also high during June 2015 (2.00 mg/l) and low during August 2015 (1.14 mg/l). Average annual mean value was also found high at station IV (1.75 mg/l) and low at station VI (1.27 mg/l). Maximum seasonal mean value of silicate was recorded in station IV (1.97 mg/l) during monsoon season and minimum in station VI(1.09 mg/l) during pre-monsoon season. Silicate values recorded maximum during monsoon season in all stations and showed a

declining trend toward reaching pre-monsoon season. This is in agreement with the findings reported from Cochin backwaters by Martin et. al. (2008, 2013).Similar finding was also reported by Akram(2002). He also well reported the importance of silicate in planktonic growth. ANOVA of silicate values showed a significant variation at 1% level between both months ($P<0.000$) and stations($P<0.003$).Silicate was found positively correlated to Nitrite (r=0.556), Nitrate (r=0.458), phosphate (r=0.266), GPP (r=0.443), NPP (r=0.452 (Table 1).

Primary Productivity

Seasonal mean distribution of GPP and NPP in the Kappil backwaters is presented in figure 6&7 respectively. Maximum GPP and NPP values were observed during monsoon season and minimum during pre-monsoon season in all stations.Highest Seasonal mean value of GPP was recorded in station V (440.96 mgC/m^3/hr)and lowest in station VI (144.60mgC/m^3/hr). Maximum seasonal mean value of NPP was also recorded in station V (368.15mgC/m^3/hr) during monsoon period and minimum in station VI (67.41 mgC/m^3/hr) during pre-monsoon period.

Primary productivity of aquatic ecosystem always depends on some physico-chemical and environmental parameters such as light, temperature, salinity and availability of nutrients (Virginia, 2005). However here in this study it was found that light penetration has no significant effect on productivity. Primary productivity was noticed high during October 2015 (GPP 497.25 mgC/m^3/hr, NPP 444.75 mgC/m^3/hr) and both these values were observed at station III. Lowest gross and net primary productivity values were noticed in station I (GPP 102.08mgC/m^3/hr, NPP 25.83 mgC/m^3/hr), during April 2016. Maximum monthly mean value of primary productivity was found during June 2015 (GPP 385.50 mgC/m^3/hr, NPP 330. 30mgC/m^3/hr) and minimum monthly mean value of GPP was noticed during April 2016 (201.79 mgC/m^3/hr) and NPP in March 2016 (130.51 mgC/m^3/hr). Highest annual mean value of productivity was found at station V (GPP 376.20 mgC/m^3/hr, NPP 314.32 mgC/m^3/hr). Lowest annual mean value of GPP was measured at station I (204.96 mgC/m^3/hr) and NPP was measured at station VI (141.65 mgC/m^3/hr). GPP and NPP values were significantly varied between months ($P<0.001$)and stations($P<0.000$) at 1% confidence level. GPP was found positively correlated with nitrate (r= 0.305), silicate (r= 0.443) and NPP (r= 0.971). While NPP was found positively correlated with silicate (r= 0.452) and GPP (r= 0.971) (Table 1).

Summer months showed a decrease in nutrient parameters. Lack of nutrient rich inflows also influenced the lower nutrient values during summer months.Maximum mean productivity values were observed during monsoon season in all stations except station III. Station III gained higher mean values during post-monsoon period. Similar maximum productivity values during monsoon and post-monsoon months also reported in Valanthakad Backwater by Meera (2010). Here in this study seasonal mean value of nutrients and productivity reaches maximum during monsoon and post-monsoon months. Bindu (2005) noticed higher primary productivity during monsoon season in Cochin Backwaters. Vaheeda (2008) also reported similar observations from brackish waters of Kodungallur area. Similar findings were also reported from Rajakkamangalam estuary in Kanyakumari (Prema *et al.*, 2004). Higher productivity values during monsoon and lower during pre-monsoon was noticed by Bijoy Nandan and Abdul

Table 1. Correlation between nutrients and primary productivity in theKappil backwaters, Kerala

	Nitrite	Nitrate	Phosphate	Silicate	GPP	NPP
Nitrite	1					
Nitrate	0.752**	1				
Phosphate	0.633**	0.583**	1			
Silicate	0.556**	0.458**	0.266*	1		
GPP	0.2	0.305**	-0.069	0.443**	1	
NPP	0.168	0.193	-0.127	0.452**	0.971**	1

Fig. 2. Distribution of nitrite in various stations of Kappil backwaters, Kerala in different seasons

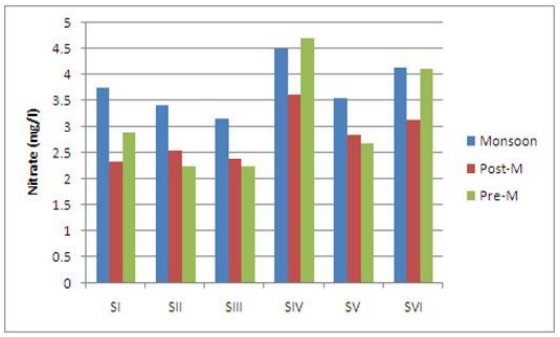

Fig. 3. Distribution of Nitrate in various stations of Kappil backwaters, Kerala in different seasons

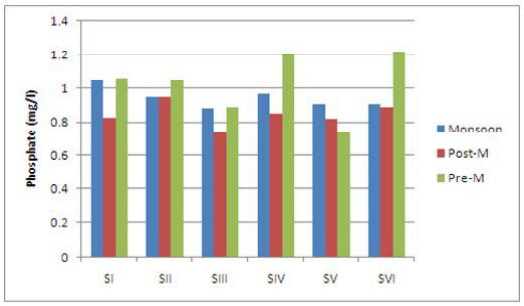

Fig. 4. Distribution of Phosphate in various stations of Kappil backwaters, Kerala in different seasons

Fig. 5. Distribution of silicate in various stations of Kappil backwaters, Kerala in different seasons

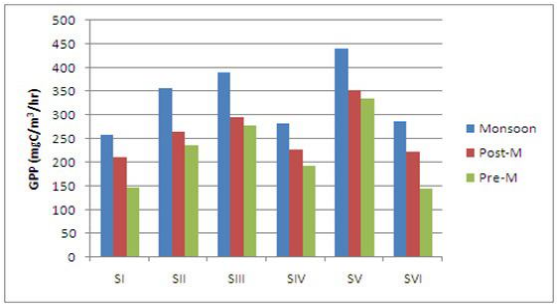

Fig. 6. Distribution of GPP in various stations of Kappil backwaters, Kerala in different seasons

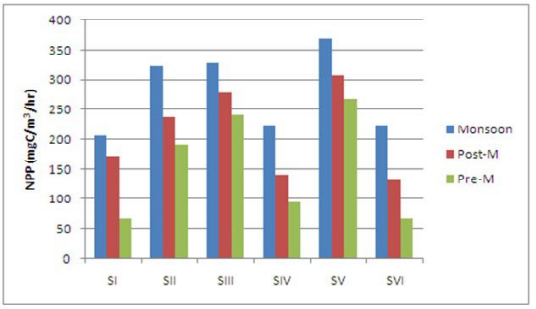

Fig. 7. Distribution of NPP in various stations of Kappil backwaters, Kerala in different seasons

Azis (1994) in Kadinamkulam estuary. Most nutrient parameters recorded maximum values during monsoon months and it might be due to the influence of surface runoff from the surrounding land and heavy river discharge.

CONCLUSION

Nitrite, nitrate and silicate gained maximum values during the monsoon months and maximum GPP and NPP values were observed during monsoon season and minimum during pre-monsoon season in all stations. Leaching of organic and inorganic wastes into the backwaters and presence of drainages may have contributed towards the deterioration in water quality, which in turn has adversely affected the planktonic growth and thereby productivity mechanism.

ACKNOWLEDGEMENTS

The first author is thankful to the University of Kerala for the award of Junior Research Fellowship and both are indebted to the Department Heads of Zoology, Botany and Chemistry, NSS College, Pandalam, Kerala.

REFERENCES

Akram K.M. 2002. Contribution of size fractions of planktonic algae to primary organic productivity in the coastal waters of Cochin, Southwest Coast of India.Ph.D. Thesis, Cochin University of Science and Technology, Kerala

Anitha G. 2014. Studies On The Hydrology And Geochemistry Of Thengapattanam Estuary. Ph.D. Thesis, Faculty of Chemistry,ManonmaniamSundaranar University, Tamil Nadu.

APHA 2012 Standard methods for the examination of water and wastewater, 6thEdition,American Public Health Association Washington D C

Berner, E.K. and Berner R.A. 1987. The global water cycle. Prentice-Hall, New Jersey.

Bhat, P.K. 2003. Hydrobiological Studies ofAghanashini Estuary, Kumta Central West Coast of India. Ph.D. Thesis,Karnatak University.

BijoyNandan and Abdul Azis, A. 1994. Primary productivity of theretiling zones in the Kadinamkulamestuary, South-west coast of India. *Mahasagar*, 27: 97-103.

Bindu Alex 2005. A study on the impact of cottage industry effluents on phytoplankton. PhD thesis. Faculty of Botany, Mahatma Gandhi University, Kerala.

Feebarani, J. 2009. Meiobenthos of Cochin backwaters in relation to macrobenthos and environmental parameters. Ph.D. Thesis, Cochin University of Science and Technology, Kerala.

Haridevi, C.K.2013. Spatial and temporal variation of phytoplankton community and their growth limiting factors in Cochin backwater. Ph.D. Thesis, Cochin University of Science and Technology.

Karuppiah, T., Balakrishnan, G., Soundarapandian, Theivasigamani, A., Anil. S.K., Ramachandran, K., Solankijitesh B. and Nithyamary, S. 2011. Studies on the physico-chemical characteristic and nutrients in the Kottakudi Estuary of Thirupulani, Ramanathapuram District, South East Coast of India. AACL Intonational Journal of the Bioflux Society, 4(3): 313-319.

Madhukumar A. 1996. Hydrochemical and sorption studies in tropical backwater systems vis a vis retting practices. Ph.D. Thesis, University of Kerala.

Manikannan, R., Asokan, S., Hameed, A and Ali, M.S, 2011. Seasonal Variations of Physico-chemical properties of the Great Vedaranyam Swamp, Point Calimere Wildlife Sanctuary, South-east Coast of India.*African Journal of Environmental Science and Technology* 5(9): 673-681.

Martin G.D., Jyothibabu R., Madhu N.V., Balachandran K.K., Maheswari Nair., Muraleedharan K.R., Arun P.K., Haridevi C.K and Revichandran C. 2013. Impact of eutrophication on the occurrence of Trichodesmium in the Cochin backwaters, the largest estuary along the west coast of India. *Environmental Monitoring Assessment*, 185(2): 1237-1253.

Martin, G.D., Vijay, G.J., Laluraj, C.M., Madhu, N.V., Joseph, T., Nair, M., Gupta, G.V.M., Balachandran, K.K. (2008).Fresh water influence on nutrient stoichiometry in a tropical estuary, Southwest coast of India.*Applied Ecology and Environment Research*, 6(1): 57-64.

Meera S. and BijoyNandan,S.2010. Water quality status and Primary productivity of Valanthakad Backwater in Kerala. *Indian Journal of Marine Sciences*, 39(1): 105-113.

Muraleedharan Nair, M.N. 1995. Studies onBeyporeestuary: Trace metals distribution and physico-chemical characteristics. Ph.D. Thesis, Cochin University of Science and Technology, Kerala.

of National Seminar on Coastal Ecosystem Management. 2-3 April, ENVIS Centre- KSCSTE and MoEF, 1-19.

Prabu, V.A., Rajkumar, M, and Perumal, P, 2008, Seasonal variations in physicochemical parameters in Uppanar estuary, Cuddalore (Southeast coast of India), Journal of Marine Biological Association of India, S0(2):161-16S.

Prema, P., Palavesam A. and Venkadesh, B. 2004. Primary productivity in a minor estuary along the south west coast of India. *Indian J. Fish.*, 51(3) : 359-364.

Ramachandra T.V. and MalavikaSolanki 2007. Ecological assessment of lentic water bodies of Bangalore. ENVIS Technical Report: 25, January 2007

Ramesh R. and Purvaja, R. 2009. Coastal ecosystem and management in India: An overview. Proc.

Ravaniah, G., Georgeenakumari, P and Murthy, C.V.N, 2010, Water quality analysis of pennar estuary, Nellore, Journal of Current Sciences, 15(2), 321-334.

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.*Current Research Journal of Biological Science* 1(3): 102- 105.

Vaheeda K.K. 2008. Ecological Studies on the Brackish Waters of Kodungallur Area, Kerala, India.PhD thesis, Mahatma Gandhi University, Kerala.

Virginia L.J. 2005. Primary productivity by phytoplankton: temporal, spatial and tidal variability in two North Carolina Tidal Creeks. M.Sc..Thesis, Faculty of Marine Science, University of North Carolina Wilmington.