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Evaluation of Organic Pollution By Palmer's Algal Pollution Index and Biodiversity Indices for Kottakayal –A Wetland of South Kerala

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ABSTACT

Quick response of phytoplankton's to environmental changes, fast population renewal and short generation time make planktons a good indicator of water quality. In the present study Palmer's pollution index and biodiversity indices such as Margalef's Species richness index, Pielou's Species evenness index, Shannon- Weiner's Species diversity indexand Simpson's dominance index were used to analyse the pollution status of Kottakayal. Results bring out the extent of organic pollution in the waterbody especially in those areas were the anthropogenic pressure is pronounced.

KEY WORDS: phytoplantons, palmer's pollution index, Margalef''sSpecies richness index, Pielou's Species evenness index, Shannon- Weiner's Species diversity index, Simpson's dominance index.

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INTRODUCTION

The benefits of freshwater natural resources on the wellbeing of mankind is incredible and ineffable. Anthropogenic pressure bringing about changes in aquatic environment are a cause of great concern. Therefore continuous monitoring of water quality and the organism inhabiting them is required.If direct or indirect environmental stressors can bring about changes in the population abundance and species diversity of an ecosystem, then these changes in the biota may be used to infer changes in the ecosystem. Here comes the significance of indicator species. Indicator species are those species that provide an indication to the prevailing environment by their presence or abundance. Eutrophication causes a decline in the biodiversity of higher trophic levels. Plankton investigations in Indian lentic ecosystems became prominent in the middle of twentieth century. These studies showed that a number of factors like nutrient status, age, morphometry and location affects the diversity and abundance of planktons and their seasonal occurrence. Hence planktons can be used as an indicator of the trophic state of a waterbody.Phytoplanktons are prokaryotic or eukaryotic phototrophic microorganisms with simple nutritional requirements.Quick response of phytoplanktons to environmental changes, fast population renewal and short generation time make them good indicators of water quality and trophic status. Biological monitoring is not limited to immediate conditions or single factor posing a change in the environment but throws light on the past disturbances and effects of multiple factors. Numerous anthropogenic and non-anthropogenic factors affects the occurrence of an organism in a multidimensional space. The degree and levels of pollution can be predicted before their effect is felt in the ecosystem through such bio -indicator studies. In the present scenario biomonitoring plays an integral part in assessing water quality and in pollution research of water bodies.

MATERIAL AND METHODS

*Kottakayal*lies between 8^0 $51^{'}8^0$ $53^{'}$ north latitude and $76^0 41^{'}$and 76^0 $42^{'}$east longitude near Pallimon-Ithikkara confluence. The wetland has an area of 2 square km. It flows through Adichanallur and Nedumpanapanchayats, of Kollam district.

Six stations were randomly selected. Surface water (about 50 litre) was filtered through 20µ Nylon mesh. Samples were fixed with 2% formaldehyde and Lugol's iodine.Standard references likePrescott,Ward and Wipplewere used in identifying the phytoplanktons. Enumeration of different species were done using Sedgwick- Rafter counting slide on a light microscope as per the procedure of Wetzel and Likens. Biodiversity indices like Margalef's Species richness index, Pielou's Species evenness index, Shannon- Weiner's Species diversity indexand Simpson's dominance index were

calculated.Algal pollution indices according toPalmer, based on genus level were used in rating organic pollution of the water body.

RESULTS AND DISCUSSIONS

Table:1Palmer's Algal Genus Pollution Index Value of Different Stations of Kottakayal During 2015-2016

Algal genera	S1			S2			S3			S4			S5			S6		
	PM	M	PtM	PM	M	PtM	PM	M	PtM	PM	M	PtM	PM	M	PtM	PM	M	PtM
Anacystis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ankistrodesmus	-	-	4	-	-	-	-	-	-	-	-	4	-	-	-	-	4	4
Chlamydomonas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chlorella	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Closterium	-	1	-	-	1	1	-	-	-	-	1	1	-	1	-	-	1	-
Cyclotella	-	-	-	-	-	-	-	-	-	5	5	-	-	-	-	-	-	-
Euglena	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gomphonema	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Lepocinclis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melosira	-	1	-	-	1	-	-	-	-	-	-	1	1	1	-	-	1	1
Micractinium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navicula	-	3	-	-	-	3	-	3	-	-	3	3	3	3	-	3	3	-
Nitzschia	-	3	3	3	-	3	-	3	-	3	3	3	3	3	3	3	3	3
Oscillatoria	-	5	-	-	-	-	-	-	-	-	5	5	-	5	-	5	5	5
Pandorina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phacus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phormidium	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Scenedesmus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stigeoclonium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Synedra	2	-	2	2	2	2	-	2	-	2	2	2	2	2	-	2	2	-
Total	**3**	**13**	**10**	**5**	**4**	**9**	**0**	**9**	**0**	**10**	**20**	**19**	**9**	**15**	**3**	**13**	**19**	**13**

*PM- Premonsoon, M- Monsoon, PtM- Post monsoon

According to Palmer, if the pollution index score is 20 or more, the score is evidence of high organic pollution. A score of 15-19 indicates probable organic pollution. Lower scores usually indicate less organic pollution.0-1 indicates lack of organic pollution.The pollution index at each site of the water body is given in table 1. Highest value of Palmer pollution index score obtained in this water body was 20 at station 4 during the monsoon months. Stations 4, 5 and 6 shows scores indicating probable organic pollution. The scores of Palmer pollution index were comparably less in station 2 and 3. It was noticed that greater scores of pollution index were obtained during monsoon months at each station.

In the present study the distribution pattern of algal flora in various sampling points of Kottakayal is given in table 2. Algal communities were dominated by *Nitzschia, Oscillatoria, Navicula, Synedra, Ankestrodesmus, Closterium, Cyclotella, Gomphonema* and *Melosira*, all of which were considered as pollution indicators [14,5,15]. *Microcystis* is considered as best single indicator of pollution . The abundance of *Microcystis* in station 4 is a good indication to organic pollution. Similar observations were made by Jose and Kumar infour temple ponds of Mattancherry, Ernakulam, Kerala.*Oscillatoria* were abundant in station 4 and 6 especially during monsoon and post monsoon months.

Table: 2 Algal Distribution of Kottakayal during 2015-2016

Genus	S1			S2			S3			S4			S5			S6		
	PM	M	PstM	PM	M	PstM	PM	M	PstM	PM	M	PstM	PM	M	PstM	PM	M	PstM
Achnanthes																	+	
Campylodiscus		+	+	+							+			+				
Nitzschia	+	+	+			+		+		+	+	+	+	+	+	+	+	+
Tabellaria	+				+			+						+			+	+
Denticula		+	+															
Cymbella												+		+				
Gomphonema	+							+										
Melosira		+	+		+							+	+	+			+	+
Navicula		+	+			+		+			+	+	+	+		+	+	
Pinnularia						+		+		+		+		+	+	+	+	
Pleurosigma		+	+		+			+			+							
Asterionella				+	+			+		+	+	+	+	+		+		
Tetracyclus				+			+	+	+	+	+	+				+	+	+
Amphora								+			+						+	
Coelastrella	+			+														
Ankistrodesmus	+									+		+					+	+
Schizochlamys		+	+		+					+		+						+
Kirchneriella												+						
Hydrodicton	+	+	+								+	+	+		+			
oedogonium				+			+	+	+		+	+				+	+	+
Bulbochaete								+					+				+	+
Actinastrum	+							+		+	+	+				+	+	+
Pediastrum						+												
Chlorococcum		+	+					+									+	
Gonium												+						+
Fragilaria	+										+	+						+
Synedra	+			+	+	+		+		+	+	+		+		+	+	
Onychonema												+		+				
Pleurotenium	+																	
Gonatozygon		+	+	+	+					+	+	+	+	+	+	+	+	+
Closterium			+			+		+				+		+			+	
Cosmarium		+	+		+			+			+	+					+	+
Desmidium		+	+		+			+		+		+					+	+
Staurastrum								+			+			+			+	+
Micrasterias		+	+		+		+		+	+	+	+		+				
Onychonema										+								
Sphaerozosma												+						
Spondylosium							+		+	+	+			+				
Zygogonium										+								
Triploceras																	+	
Mougeotia		+	+		+			+		+	+	+		+	+	+	+	+
Zygnema																		+
Spirogyra				+			+		+	+	+	+	+	+	+			+
Ulothrix		+	+		+		+	+	+	+	+	+	+	+		+	+	
Oscillatoria		+									+	+		+		+	+	+
Agmenillum		+	+		+						+	+		+				
Microcystis	+			+						+	+	+	+	+				+
Spirulina										+	+	+		+				
Stichococcus												+						

Oocystis						+	+		+			+		+				+
Nostoc												+		+				+
Anabaena												+						
Cyclotella										+	+					+		
Dinobryon		+	+		+						+			+				

Table:3 Diversity indices of different sampling stations in the year 2015-2016

Stations	Seasons	Shannon (H)	Pielous (j)	Simpson (λ)	Margalef (d)
SITE 1	Post Monsoon	2.63	0.89	0.09	3.54
	Pre Monsoon	2.63	0.92	0.15	3.04
	Monsoon	2.47	0.83	0.11	3.44
SITE 2	Post Monsoon	2.25	0.91	0.12	2.32
	Pre Monsoon	2.65	1.05	0.30	2.24
	Monsoon	2.39	0.87	0.12	2.74
SITE 3	Post Monsoon	2.29	0.79	0.17	3.92
	Pre Monsoon	2.33	0.87	0.17	2.79
	Monsoon	3.13	0.88	0.06	7.59
SITE 4	Post Monsoon	3.12	0.83	0.07	7.19
	Pre Monsoon	3.82	1.10	0.15	5.48
	Monsoon	2.79	0.77	0.13	6.32
SITE 5	Post Monsoon	2.37	0.91	0.10	3.51
	Pre Monsoon	2.86	0.95	0.10	3.77
	Monsoon	2.83	0.82	0.10	5.31
SITE 6	Post Monsoon	2.97	0.83	0.09	6.33
	Pre Monsoon	3.01	0.94	0.08	4.70
	Monsoon	3.05	0.88	0.07	5.30

In Simpson index the possible range of values are between 0 and 1, where values near 0 are indicative of the least evenly distributed communities and values near 1 are indicative of the most evenly distributed communities. In Kottakayal during the study period Simpson index varied from 0.06 to 0.3, this indicates that the lake is not free from organic pollution, because maximum diversity in phytoplankton's is seen in a non-polluted water body.Margalef's index relates to the number of species to the total number of individuals. The values ranged from 2.24 to 7.59. Lower levels of this index shows a rise in pollution level. Shannon –Wiener index ranged from 2.29 to 3.82, these low values too indicate organic pollution in the water body. Values of Shannon index above 3 indicates clean water and below 3 indicates polluted water. The values of Pielou's index ranged from 0.77 to

1.10. The values of Palmer's pollution index and Diversity indices reveal the pollution status of this waterbody. Findings of Newall and Walsh also indicated similarities in their observation and confirmed the importance of such assemblage of algae with organic pollution in water bodies. The study concludes that Kottakayal is in danger of being polluted by human activities like our other freshwater reserves and all necessary precautions should be taken to conserve our water resources.

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