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# COMPILATION OF THE PHOSPHATE CONTENT OF THE UPPER AND LOWER ZONES OF A WETLAND ECOSYSTEM

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## ABSTRACT

Wetlands have always been at one time or other a community dumping site of waste of industrial commercial agricultural, municipal or domestic origin and hence threatened by accelerated sedimentation. Kerala notwithstanding its limited geographical extent supports a rich diversity of wetland ecosystems. Ashtamudi lake in Kollam district is the second largest estuary backwater complex in Kerala next only to Vembanad lake. It is either being polluted, drained or filled up to give way for development .The encroachment ,mining and reclamation in many locations leads to loss of biodiversity as well as changes in the ecosystem functioning. An attempt was thus made in the present study to estimate the variations of phosphate content in the upper and lower extremes of water of the Thekkumbhagam creek of Ashtamudi estuary. The study recorded a maximum PO4.P value during the monsoon and a minimum during the pre-monsoon period. Higher concentration of PO4.P during monsoon season might have been due to the large inputs of domestic sewages, fertilizers from the adjacent agricultural lands, poultry waste, prawn processing wastes, slaughter wastes, hospital wastes etc. The high PO4.Pconcentration is an important feature associated with sewage and industrial pollution in this creek and hence PO4.P concentration could be taken as an index to identify the extent of pollution in this study area. This contribution attempts to evaluate the variations in phosphate phosphorous content along with reminding the need for the conservation of this wetland.

**KEYWORDS:** Phosphate phosphorous ($PO_4$.P), eutrophication, tidal incursion.

## 1. INTRODUCTION

Wetlands appear to be one of the most preferred landfills for dumping solid wastes from a variety of orgins and an ultimate end point for discharging untreated industrial and domestic effluents. Therefore, there is a remarkable decline of wetlands and accurate scarcity of water in many parts of the country. It is pertinent to note that we must phase out the use of pesticides and chemical fertilizers. Unpredictability of the rains, frequent droughts and floods, the dare consequence of global warming and climate change demands the most urgent action for saving these wetlands.

Phosphorous is most often the limiting factor in a water body, it controls therefore provides the key to control eutrophication. In most natural surface waters phosphate ranges from 0.005 to 0.02 mg/l PO4.P. High concentration of phosphate can indicate the presence of pollution and are largely responsible for eutrophication. Phosphorous is a critical component of proteins, nucleic acids, nucleotide phosphate and other organic compounds. Phosphorous may enter the lake from organic matter, rocks sediments and anthropogenic pollution from synthetic detergents. Unpolluted lakes generally have phosphorous concentrations between 0.01 and 0.05 mg/l (Wetzel, 1983).[10] Together with water movement, these processes of removal and return give rise to seasonal variations in the distribution of this element (Koroleff, 1983).[4] The biogeochemical cycle of phosphorous in estuaries and its distribution and seasonal variations have been reported by many authors (Correll et al., 1975;[2] Aston 1980).[1] Although phosphorous are not toxic to man, animals or fish, water guidelines have been proposed because phosphorous may stimulate algal growth and thus create taste and odour problems.

Restoration is quite a task, once the welands are occupied for non-wetland uses, Hence attempts should be made to prevent corrosion of wetlands. Here an attempt is made to evaluate the fluctuations of phosphate content of the surface and bottom waters of the Thekkumbhagam creek of the Ashtamudi estuary. Considering the ecosystem values that these wetlands provide and its alarming rate of decline we should accord the highest priority for its conservation and sustainable use of this wetland.

## 2. MATERIALS AND METHODS

Monthly water samples for hydrographical studies have been made from four selected sites of Thekkumbhagam creek of Ashtamudi estuary in Kollam district for a period of two years (From June 2008 to May 2010), covering three prominent seasons of the year (pre-monsoon, monsoon and post-monsoon). All collections were made invariably between 6 am and 8 am. Surface and bottom water samples were taken in good quality polyethylene containers for the analysis of certain physico-chemical factors. Maximum care was taken in taking samples, their preservatives, storage and analysis. The samples were brought to the laboratory immediately after collection, for analyzing its various physico-chemical characteristics using standard methods. The determination of Phosphate phosphorous is based on the reaction of ions with an acidified molybdate reagent to yield a phosphomolybdate complex which then reduced to highly coloured blue complex which is measured at 882 nm (Grasshoff et al., 1983).[3] The data collected at monthly intervals from all the stations were statistically analysed, with a view to understand the nature of variations in the physico-chemical parameters between stations and seasons. Analysis includes Mean,Standard Deviation, ANOVA.

## 3. RESULT

In Station 1, the phosphate of surface water ranged from 0 to 512µgPO4.P/l in 2008-2009 and from 0 to 171.72 µg PO4.P/l in 2009-2010. The mean values during monsoon, post-monsoon, pre-monsoon were 181.56 ± 110.61, 117.59 ± 36.39, 42.86 ± 27.74 respectively in the first year and 170.85 ± 114.16, 85.78 ± 30.37, 53.35± 26.95 respectively in the second year. The annual mean ± SE was 114 ± 39.75 in2008-2009 and 103.39 ± 39.47 in 2009-2010(Table 1.1 and Fig 1.1 a & 1.1b).

In Station 1, the phosphate of bottom water ranged from 42.85 to 213.33µg PO4.P/l in 2008-2009 and from 42.85 to 213.33 µg PO4.P/l in 2009-2010.The mean values during monsoon, post-monsoon, pre-monsoon were 149.72 ± 40.9,108.33 ± 22.62, 64.28 ± 12.37 respectively in the first year and 138.99 ± 31.94, 74.98± 20.5, 53.56 ± 10.72 respectively in the second year. The annual mean ± SE was107.44 ± 17.97 in 2008-2009 and 89.18 ± 16.16 in 2009-2010 (Table 1.1 and Fig 1.2 a & 1.2b).

In Station 2, the phosphate of surface water ranged from 42.85 to 554.86 µg PO4.P/l in 2008-2009 and from 42.85 to 554.85 µg PO4.P/l in 2009-2010.The mean values during monsoon, post-monsoon and pre-monsoon were 503.25 ±73.46, 826 ± 516.41, and 249.75 ± 101.2 respectively in the first year and 213.63 ±114.1, 74.98 ± 20.5, 106.9 ± 36.89 respectively in the second year. The annual mean ±SE was 135.49 ± 40.29 in 2008-2009 and 131.84 ± 40.81 in 2009-2010(Table 1.1 and Fig 1.1 a & 1.1b).

In Station 2, the phosphate of bottom water ranged from 42.85 to 1066.6 µg PO4.P/l in 2008-2009 and from 42.85 to 1066.6 µg PO4.P/l in 2009-2010.The mean values during monsoon, post-monsoon and pre-monsoon were 341.61 ±242.5, 192.19 ± 70.66, and 85.69 ± 17.48 respectively in the first year and 320.22 ±249, 107.19 ± 27.72, 85.69 ± 17.48 respectively in the second year. The annual mean± SE was 206.49 ± 82.64 in 2008-2009 and 171.04 ± 82.17 in 2009-2010. (Table 1.1 and Fig 1.2 a & 1.2b).

In Station 3, the phosphate of surface water ranged from 42.85 to 176.42 µg PO4.P/l in 2008-2009 and from 42.85 to 554.6 µg PO4.P/l in 2009-2010.The mean values during monsoon, post-monsoon and pre-monsoon were 215.08 ±57.32, 128.52 ± 46.26, 117.76 ± 26.92 respectively in the first year and 202.99 ±66.03, 181.57 ± 76.69, 96.47 ± 10.7 respectively in the second year. The annual mean± SE was 153.79 ± 27.05 in 2008-2009 and 160.32 ± 33.68 in 2009-2010(Table 1.1 and Fig 1.1 a & 1.1b).

In Station 3, the phosphate of bottom water ranged from 42.85 to 384µg PO4.P/l in 2008-2009 and from 42.85 to 299.95 µg PO4.P/l in 2009-2010. The mean values during monsoon, post-monsoon and pre-monsoon were 224.63 ± 32.04,160.58 ± 64, and 96.41 ± 10.7 respectively in the first year and 278.51 ± 51.01, 107.12± 27.66, 171.39 ± 34.96 respectively in the second year. The annual mean ± SE was 160.53 ± 26.93 in 2008-2009 and 139.19 ± 23.64 in 2009-2010. (Table 1.1 and Fig 1.2 a & 1.2b).

In Station 4, the phosphate of surface water ranged from 85.71 to 342.8µg PO4.P/l in 2008-2009 and from 42.85 to 341.3 µg PO4.P/l in 2009-2010. The mean values during monsoon, post-monsoon and pre-monsoon were 236.66 ± 36.48, 107.11± 12.35, 107.11 ± 12.35 respectively in the first year and 235.03 ± 44.34, 107.19 ±27.72, 150.29 ± 22.09 respectively in the second year. The annual mean ± SE was150.29 ± 22.09 in 2008-2009 and 156.91 ± 23.69 in 2009-2010(Table 1.1 and Fig 1.1 a & 1.1b).

In Station 4, the phosphate of bottom water ranged from 42.85 to 342.8µg PO4.P/l in 2008-2009 and from 42.85 to 384 µg PO4.P/l in 2009-2010. The mean values during monsoon, post-monsoon and pre-monsoon were 278.51 ± 51.01, 107.12 ± 27.66, and 171.39 ± 34.96 respectively in the first year and 256.63 ± 52.15, 96.49 ± 27.03, 160.51 ± 20.34 respectively in the second year. The annual mean ± SE was 185.67 ± 29.52 in 2008-2009 and 171.21 ± 21.29 in 2009-2010 (Table 1.1 and Fig 1.2 a & 1.2b).

ANOVA comparing phosphate of surface water values between stations showed variations between seasons and for periods within seasons significant at 1% level for the two years. ANOVA comparing phosphate values between the years of study showed variations between seasons and for periods within seasons significant at 1% level for station 1. But in the case of station 3, 4 showed variations between years significant at 1% level (Table 1.2 &1.3). ANOVA comparing phosphate of bottom water between the stationsfor the two years of study showed variation between seasons significant at 5% level.ANOVA comparing the phosphate of bottom water of Station 1 between the years of study showed variations between seasons significant at 1% level and periods within seasons significant at 5% level. Phosphate of bottom water comparison between years of study for station 2 and station 3 is such that station 2 showed variations between years significant at 1% level while station 4 showed no significant variations (Table1.4 & 1.5).

**Table 1.1: Phosphate (µg $PO_4$.P/l) of water (2008-2010).**

| Year | Season | Month | Phosphate (µg $PO_4$.P/l) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Station 1 | | Station 2 | | Station 3 | | Station 4 | |
| | | | Surface | Bottom | Surface | Bottom | Surface | Bottom | Surface | Bottom |
| 2008-2009 | Monsoon | JUN | 85.71 | 128.5 | 128.5 | 128.5 | 171.42 | 257 | 214.3 | 342.8 |
| | | JUL | 85.71 | 214.2 | 42.85 | 42.85 | 176.42 | 256 | 213.33 | 342.8 |
| | | AUG | 42.85 | 42.85 | 85.71 | 128.5 | 128.5 | 257 | 176.2 | 299.95 |
| | | SEP | 512 | 213.33 | 554.66 | 1066.6 | 384 | 128.5 | 342.8 | 128.5 |
| | Post-Monsoon | OCT | 42.85 | 85.71 | 42.85 | 85.71 | 257 | 128.15 | 128.5 | 42.85 |
| | | NOV | 128.5 | 176.2 | 128.5 | 384 | 85.71 | 342.8 | 85.71 | 128.5 |
| | | DEC | 213.33 | 85.71 | 171.42 | 213.33 | 128.5 | 128.5 | 128.5 | 171.42 |
| | | JAN | 85.71 | 85.71 | 85.71 | 85.71 | 42.85 | 42.85 | 85.71 | 85.71 |
| | Pre-Monsoon | FEB | 85.71 | 85.71 | 171.42 | 128.5 | 128.5 | 85.71 | 128.5 | 171.42 |
| | | MAR | 85.71 | 42.85 | 85.71 | 85.71 | 42.85 | 128.5 | 85.71 | 85.71 |
| | | APR | 0 | 42.85 | 42.85 | 42.85 | 128.5 | 85.71 | 85.71 | 171.42 |
| | | MAY | 0 | 85.71 | 85.71 | 85.71 | 171.2 | 85.71 | 128.5 | 257 |
| 2009-2010 | Monsoon | JUN | 42.85 | 85.71 | 85.71 | 85.71 | 213.33 | 299.95 | 257 | 384 |
| | | JUL | 42.85 | 171.2 | 85.71 | 42.85 | 128.5 | 213.33 | 213.33 | 257 |
| | | AUG | 85.71 | 85.71 | 128.5 | 85.71 | 85.71 | 257 | 128.5 | 257 |
| | | SEP | 512 | 213.33 | 554.6 | 1066.6 | 384.4 | 128.5 | 341.3 | 128.5 |
| | Post-Monsoon | OCT | 85.71 | 128.5 | 85.71 | 128.5 | 384.4 | 128.5 | 171.72 | 85.71 |
| | | NOV | 42.85 | 42.85 | 42.85 | 85.71 | 213.33 | 85.71 | 128.5 | 85.71 |
| | | DEC | 171.72 | 85.71 | 128.5 | 171.72 | 85.71 | 85.71 | 85.71 | 171.72 |
| | | JAN | 42.85 | 42.85 | 42.85 | 42.85 | 42.85 | 42.85 | 42.85 | 42.85 |
| | Pre-Monsoon | FEB | 42.85 | 42.85 | 213.33 | 128.5 | 85.71 | 171.72 | 171.72 | 128.5 |
| | | MAR | 128.5 | 42.85 | 85.71 | 85.71 | 85.71 | 128.5 | 128.5 | 128.5 |
| | | APR | 0 | 42.85 | 85.71 | 85.71 | 85.71 | 42.85 | 128.5 | 171.72 |
| | | MAY | 42.85 | 85.71 | 42.85 | 42.85 | 128.5 | 85.71 | 85.33 | 213.33 |

**Table 1.2: ANOVA testing Phosphate of surface water between the stations and seasons.**

| | 2008-2009 | | | | 2009-2010 | | | |
|---|---|---|---|---|---|---|---|---|
| Source | DF | Sum of squares | Mean Sum of squares | F Ratio | DF | Sum of squares | Mean Sum of squares | F Ratio |
| Total | 47 | 595388.60 | | | 47 | 674222.80 | | |
| Between stations | 3 | 11779.40 | 3926.50 | 1.00 | 3 | 25096.80 | 8365.60 | 1.60 |
| Between seasons | 2 | 124476.50 | 62238.30 | 16.34** | 2 | 111435.50 | 55717.80 | 10.62** |
| Periods within seasons | 9 | 333469.60 | 37052.18 | 9.73** | 9 | 364595.70 | 40150.63 | 7.72** |
| Error | 33 | 125663.10 | 3807.00 | | 33 | 173094.90 | 5245.29 | |

**Table 1.3: ANOVA testing Phosphate of surface water between the years of study in stations.**

| | Station 1 | | | | Station 2 | | | |
|---|---|---|---|---|---|---|---|---|
| Source | DF | Sum of squares | Mean Sum of squares | F Ratio | DF | Sum of squares | Mean Sum of squares | F Ratio |
| Total | 23 | 414841.50 | | | 23 | 243.70 | | |
| Between years | 1 | 675.60 | 675.60 | 0.70 | 1 | 42.90 | 42.90 | 3.90 |
| Between seasons | 2 | 66133.40 | 33066.70 | 32.47** | 2 | 26.90 | 13.50 | 1.22 |
| Periods within seasons | 9 | 336829.80 | 37425.53 | 36.75** | 9 | 52.63 | 5.85 | 0.53 |
| Error | 11 | 11202.75 | 1018.43 | | 11 | 52.63 | 5.85 | |

| Source | Station 3 | | | | Station 4 | | | |
|---|---|---|---|---|---|---|---|---|
| | DF | Sum of squares | Mean Sum of squares | F Ratio | DF | Sum of squares | Mean Sum of squares | F Ratio |
| **Total** | 23 | 149.60 | | | 23 | 869.20 | | |
| **Between years** | 1 | 33.70 | 33.70 | 5.3* | 1 | 612.50 | 612.50 | 55** |
| **Between seasons** | 2 | 1.50 | 0.70 | 0.12 | 2 | 3.60 | 1.80 | 0.16 |
| **Periods within seasons** | 9 | 44.52 | 4.95 | 0.78 | 9 | 130.73 | 14.53 | 1.31 |
| **Error** | 11 | 69.92 | 6.36 | | 11 | 122.41 | 11.12 | |

*** denote significance (p < .05)**
**** denote significance (p < .01)**

**Table 1.4: ANOVA testing Phosphate of bottom water between the stations and seasons (2008-2010).**

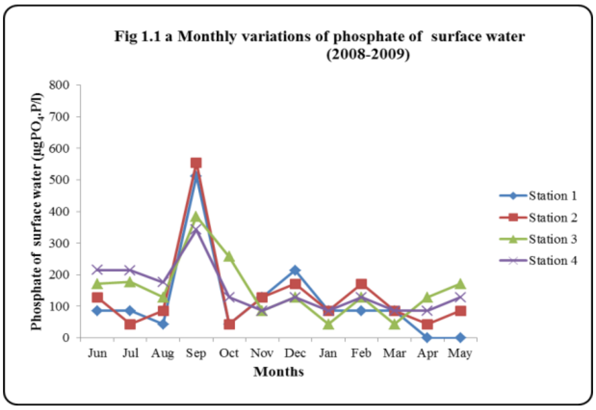
| Source | 2008-2009 | | | 2009-2010 | | |
|---|---|---|---|---|---|---|
| | Sum of squares | Mean Sum of squares | F Ratio | Sum of squares | Mean Sum of squares | F Ratio |
| **Total** | 1220717.00 | | | 1151840.00 | | |
| **Between stations** | 65784.50 | 21928.20 | 0.90 | 53913.50 | 17971.20 | 0.80 |
| **Between seasons** | 178971.30 | 89485.60 | 3.76* | 206154.60 | 103077.30 | 4.55* |
| **Periods within seasons** | 191296.60 | 21255.18 | 0.89 | 144554.30 | 16061.58 | 0.71 |
| **Error** | 784664.80 | 23777.72 | | 747217.40 | 22642.95 | |

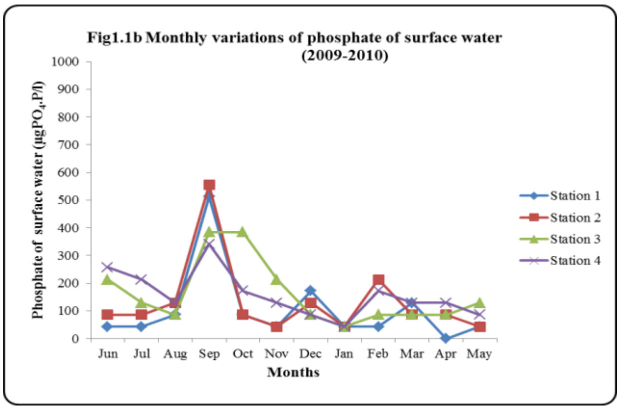
**Table 1.5: ANOVA testing Phosphate of bottom water between the years of study in stations.**

| Source | Station 1 | | | Station 2 | | |
|---|---|---|---|---|---|---|
| | Sum of squares | Mean Sum of squares | F | Sum of squares | Mean Sum of squares | F |
| **Total** | 79127.70 | | | 32850540.00 | | |
| **Between years** | 2002.10 | 2002.10 | 1.80 | 7935046.00 | 7935046.00 | 7* |
| **Between seasons** | 29725.50 | 14862.70 | 13.18** | 763626.00 | 381813.00 | 0.34 |
| **Periods within seasons** | 35000.13 | 3888.90 | 3.45* | 11716155.00 | 1301795.00 | 1.15 |
| **Error** | 12399.95 | 1127.27 | | 12435720.00 | 1130520.00 | |

| Source | Station 3 | | | Station 4 | | |
|---|---|---|---|---|---|---|
| | Sum of squares | Mean Sum of squares | F | Sum of squares | Mean Sum of squares | F |
| **Total** | 4761054.00 | | | 255860800.00 | | |
| **Between years** | 2278375.00 | 2278375.00 | 20.3** | 20896520.00 | 20896520.00 | 2.00 |
| **Between seasons** | 50801.30 | 25400.60 | 0.23 | 17741200.00 | 8870602.00 | 0.83 |
| **Periods within seasons** | 1196941.00 | 132993.00 | 1.18 | 99955440.00 | 1106160.00 | 1.04 |
| **Error** | 1234937.00 | 112267.00 | | 117469000.00 | 1067900.00 | |

* denote significance (p < .05)
** denote significance (p < .01)



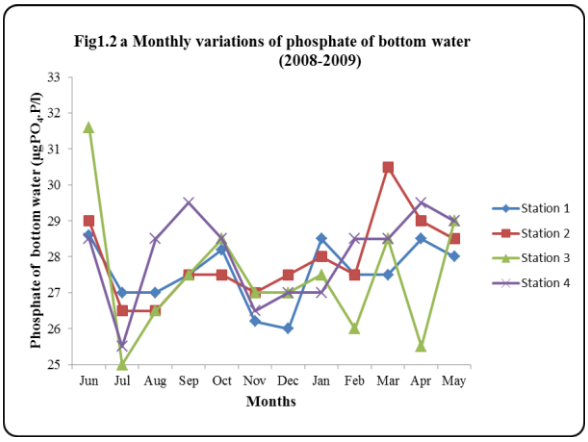



Fig1.2 a Monthly variations of phosphate of bottom water (2008-2009)

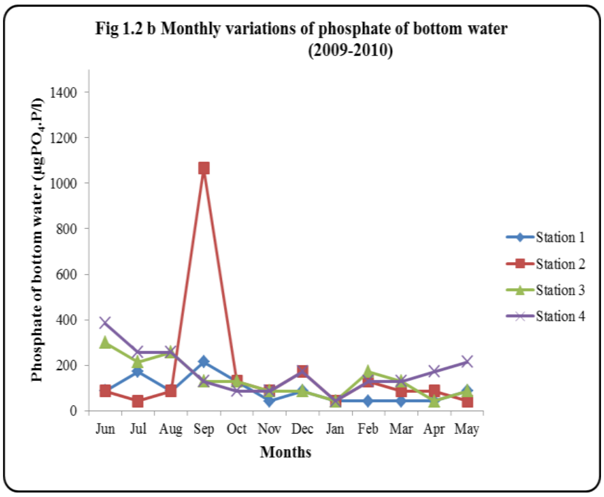



Fig 1.2 b Monthly variations of phosphate of bottom water (2009-2010)

## 4. DISCUSSION

Phosphorous is contributed to estuaries from domestic sewage and industrial effluents disposal in to rivers and from tidal waters. Rivers are the major source of Phosphorous inputs to estuaries. Weathering of earth's crust and surface water transport deliver Phosphorous to coastal waters through rivers. In the present study the PO4.P of surface water value ranged from 0 to 554.66 µg/l and PO4.P of bottom water from 0 to 1066.6µg/l in 2008-2009. The PO4.P of surface water varied from 0 to 1066 µg/l and the PO4.P of bottom water from 42.85 to 1066 µg/l in 2009-2010 The study recorded a maximum PO4.P value during the monsoon and a minimum during the pre-monsoon period. Rainfall and river discharge may result in massive transportation of sediment and a rise in phosphate during the period. Higher concentration of PO4.P during monsoon season might have been due to the large inputs of domestic sewages, fertilizers from the adjacent agricultural lands, poultry waste, prawn processing wastes, slaughter wastes, hospital wastes etc. The high PO4.Pconcentration is an important feature associated with sewage and industrial pollution in this creek and hence PO4.P concentration could be taken as an index to identify the extent of pollution in this study area. The reason for the low PO4.P concentration during pre-monsoon may be attributed to utilization of phosphate by phytoplankton. This report agrees with the findings of (Senthilkumar et al., 2002,[9] Rajasegar, 2003).[7] The recorded high concentration of PO4.P during monsoon season might probably be due to intrusion of upwelling sea water in to the creek, which in turn increased the level of phosphate, which is in conformation with the studies conducted by Nair et al., (1984).[5] High density of phytoplankton and the resultant increased utilization of phosphate might have resulted in the decrease of nutrient during the pre-monsoon and late post-monsoon months. This agrees with the research findings of Padmavathi and Satyanarayana (1999).[6] and Renjith et al., (2004).[8] The present study indicated high PO4.P concentration due to incidence of domestic, industrial, poultry, slaughter, fish processing waste etc. The present observation showed that the behavior of PO4.P in the coastal environment particularly in the shore water and estuaries may exhibit considerable seasonal variation depending upon the local condition like rainfall, quantum of freshwater inflow, tidal incursion and some biological activity like phytoplankton uptake and regeneration.

## 5. CONCLUSION

Biodiversity of the wetlands are being lost continuously due to serious anthropogenic factors leading to serious anthropogenic factors leading to serious pollution problems culminating in the very existence of the different organisms and its extermination. Considerable area of backwaters has already been lost due to reclamation for agricultural, mining, urban area development and similar activities. These wetlands are priceless heritage serving to a variety of economic activities apart from fisheries. So, stringent regulatory measures are to be implemented to maintain the present carrying capacity of the water body.

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