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An Assessment of the Biological Oxygen Demand of Thekkumbhagam creek of Ashtamudi estuary

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Abstract

In Kerala, India, the economy has been severely damaged by over population pressures. But even with this pressure, state remains a beautiful location with an abundance of water bodies. Ashtamudi estuary, being the second largest estuarine system in Kerala is an extensive palm shaped water body with eight prominent arms adjoining the Kollam town. Thekkumbhagam creek is the part of the Ashtamudi estuary which envelopes Thekkumbhagam, the biggest island of Ashtamudi estuary. During the study of the present work, it was found that there were various sources of pollution responsible for the deterioration of the water quality of the Thekkumbhagam creek. Moreover this creek as per the study conducted seems to be one with great economic, cultural, aesthetic values among the eight creeks of the Ashtamudi Lake. Further these studies will go long way in helping the authorities concerned as well as the local people to take suitable measures needed for restoring the health of this polluted area and in preserving the pristine nature of this creek besides sustainable utilization of its resources. Taking this into account, four stations of this creek were selected for the estimation of Biological Oxygen Demand that showed a comparatively high value which would give an idea about the water quality status of the entire creek reminding the conservation and sustainable development of this magnificent panoramic view.

Keywords: BOD, creek, Ashtamudi estuary, bio-degradable.

1. Introduction

Water, the wonderful entity is the basis of life on earth. Estuaries, like the rest of the world are still not adequately protected from human disturbances. When any material containing biodegradable organic matter such as food particles or sewage is released in to a water body, the process of utilizing the food or sewage by microorganisms causing stress on the dissolved oxygen content of the water. Biological Oxygen Demand is not precisely quantifiable in the manner in which most other water quality parameters are. At best, Biological Oxygen Demand is a semi-quantitative measure of biodegradable organic waste contained in any water/waste water. Measurement of BOD is thus crucial in the assessment of organic pollution.

Without the knowledge of water quality, it is difficult to understand the biological phenomenon fully, because the chemistry of water reveals much more about the ecosystem's metabolism and explains the general hydrobiological interrelationships (Arumugan, 2002) [3]. 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. The rapid industrialization and the aquaculture practices along the river systems and the coastal areas have brought considerable decline in the water quality of brackish water and the estuaries (Sundaramanickam *et al.*, 2008) [6].

The present study is about the seasonal variations of BOD in the Thekkumbhagam creek of Ashtamudi estuary, a tropical estuary of Kerala. It flows through Kollam district of Kerala, which is one of the largest and deepest wetland ecosystem. The study indicates that this wetland is subjected to acute pressure owing to rapid reclamation activities and indiscriminate utilization in the name of development. Thus the investigation explains the need for conserving this valuable natural resource for sustainable development and environmental protection that exhibited a high level of BOD.

2. Materials and Methods

Collection of water samples for hydrographical studies had been made from four selected sites of the Thekkumbhagam creek of Ashtamudi estuary in Kollam district for a period of two years (June 2008 to May 2010), covering three prominent seasons of the year (pre-monsoon, monsoon and post-monsoon) was measured by incubating the sample in a BOD incubator at 20 ^{0}C for 5 days followed by estimation of dissolved oxygen content using modified Winkler's method (APHA, 1985; APHA, 1998) [2, 1].

3. Result and Discussion

In the case of station 1, the BOD value ranged from 1.85 to 2.08mg/l in 2008-2009 and from 2 to 2.5 mg/l in 2009-2010. The mean ± SE value was 1.979 ± 0.067 in the first year and 2.2 ± 0.153 in 2009-2010(Table1 and Fig 1 & 2).In Station 2, the BOD values ranged from 1.68to 4.62 mg/l in 2008-2009 and from 1.9 to 4mg/l in 2009-2010. The mean±SEvalues were 3.273 ± 0.858in 2008-2009 and 3.253 ± 0.678 in 2009-2010.In Station 3, the BOD values ranged from 0 to 4.86 mg/l in 2008-2009 and from 1 to 4.6 mg/l in 2009-2010. The mean ± values were 3.340 ± 1.278 in 2008-2009 and 3.367 ± 1.184 in 2009-2010.In Station 4, the BOD value ranged from 8 to 14 mg/l in 2008-2009 and from 6 to 12 in 2009-2010. The mean ± SE values were 11.333 ± 1.764 in 2008-2009and 9.167 ± 1.740 in 2009-2010.For statistical evaluation of BOD, we are considering only stations not seasons since three seasons together constituted a single observation. ANOVA showed significant variations between stations at 1% level for the entire period of study (Table2&3). Tukey test revealed significant variations between stations considered as a group such as for station 1 and 4, station 2 and 4, station 3 and 4 in the first year and station 1 and 4, station2 and 4, station 3 and 4 at 1% level.

Table 1: Biological Oxygen Demand (mg/l) of water (2008-2010)

Year	Season	Biological oxygen demand			
		Station 1	Station 2	Station 3	Station 4
2008-2009	Monsoon	2	4.62	4.86	14
	Post-Monsoon	1.85	3.52	4.36	8
	Pre-Monsoon	2.08	1.68	0.8	12
2009-2010	Monsoon	2	4	4.5	12
	Post-Monsoon	2.1	3.86	4.6	6
	Pre-Monsoon	2.5	1.9	1	9.5

Table 2: ANOVA of testing Biological Oxygen Demand between stations (2008-2009)

Source	DF	Sum of squares	Mean sum of squares	F ratio
Total	3	197.87		
Between stations	8	164.96	54.98	13.36**
Error	11	32.90	4.11	

Table 3: ANOVA of testing Biological Oxygen Demand between stations (2009-2010)

Source	DF	Sum of squares	Mean sum of squares	F ratio
Total	3	119.18		
Between stations	8	89.71	29.90	8.118**
Error	11	29.47	3.68	

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

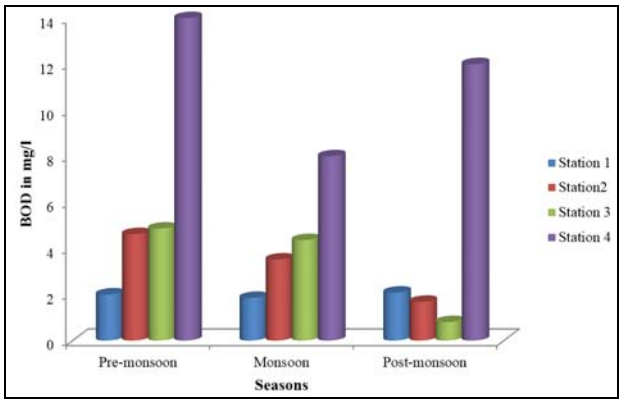

Fig 1: Seasonal variations of BOD in the stations (2008-2009)

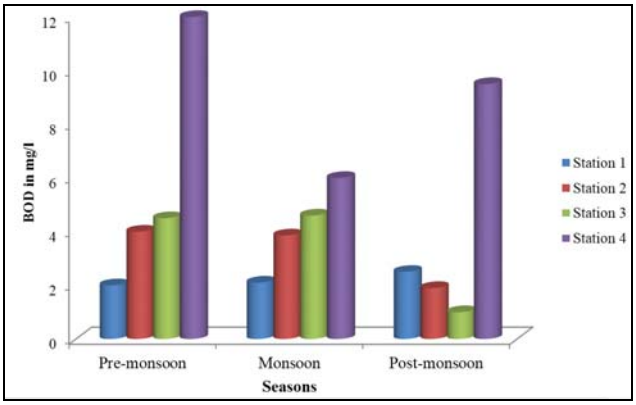

Fig 2: Seasonal variations of BOD in the stations (2009-2010)

Dissolved oxygen is probably the most universally applied water quality criterion while BOD is of vital importance in pollution monitoring. Waters with BOD levels less than 4 mg/l are regarded as clean and those with BOD levels greater than 10 mg/l are considered as polluted as they contain large amounts of degradable organic matter (Mc Neely *et al*., 1979) [4]. In the present study the seasonal BOD ranged from 0.8 to 14 mg/l in 2008-2009 and 1mg/l to 12 mg/l in 2009-2010. Maximum BOD values were encountered during monsoon season and minimum values in post-monsoon season. During monsoon season, surface run off causes waste and sewage from the surrounding areas, thereby increasing the respiratory

activity of the heterotrophic organisms. This agrees with the findings of Singhal *et al.,* (1986) [5]. Thus this might be the reason for lowest dissolved oxygen and highest BOD values in monsoon. The seasonal BOD for station 4 is comparatively higher due to the effect of dead and decaying matter and the extensive stress arising from the hospital discharges, domestic, fish processing centre's, slaughter wastes etc. This happens because micro-organisms utilize organic matter resulted in enhanced microbial activity. Consequently stronger is the stress on dissolved oxygen or the demand for it when BOD is high, the meager supply of dissolved oxygen available is rapidly depleted below dissolved oxygen of 4 mg/l, most of the fishes begin to get severely stressed and the moment dissolved oxygen reaches zero maximum fish kill occurs. Due to anthropogenic impacts, as the sewage falls in to a lake, it also brings with it nitrogen, phosphorous and other nutrients that caused the lake to become eutrophic. As a result the plants die, they contribute organic matter to water thereby lifts it's BOD and further depletes its dissolved oxygen. So the heavy inflow of the sewage continues, the lake gets gradually covered with plant debris and silt, till it has no space left for water that will signal the death of lake. Thus BOD is an indicator parameter to know the presence of biodegradable matter in the waste water and express the degree of contamination.

4. Conclusion

Ashtamudi estuary of extra-importance for its hydrologic functions, biodiversity, rich fishery resources and is also a good source of fin fishes, prawns, crabs and clams that provides livelihood to thousands of people. The main threats encountered are environmental sanitation, dumping of solid waste in and around the estuary and poor cleanliness of the regions surrounding the estuary. This creek one of the foremost centres of marine fish production and landings along the Kerala coast is now on decline due to inadequate management of the estuary. The study indicates a high level of Biological Oxygen Demand that revealed lesser dissolved oxygen content that would be harmful for the survival of fishes. Having recognized the biodiversity values of this creek, it is the responsibility of us to restore and conserve them.

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