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ASSESSMENT OF SOME HYDROLOGICAL PARAMETERS OF ULHAS RIVER ESTUARY, IN THE VICINITY OF THANE CITY, MAHARASHTRA STATE.

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Abstract:

Study of coastal water quality plays important role in evaluating and determining the pollution status and health of the water. Ulhas river estuary is one of the important water bodies in Thane district. Entire stretch of estuary was arbitrarily divided into three zones. Physical and chemical variables of water were monitored month-wise in the year 2004-2005. In the present study the entire stretch of estuary showed high values of BOD, PO_4-P, NO_3-N, Suspended solids and hypoxia suggesting deterioration of the estuary.

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Introduction :

The Ulhas River is mainly a monsoon fed river and the fresh water flow dwindles down during non-monsoon seasons. The estuarine part of the Ulhas River commences from S-E near Kalyan –Dombivli railway station head wards, meanders for about 40 km. before it joins the Arabian Sea towards N-E at Vasai creek situated between the latitude $18^0.45$' to $19^0.16$' N and longitude $72^0.42$' to $73^0.20$', E on the world map. (Fig.1). The Ulhas River estuary is characteristic in its environmental conditions due to the shallow depth, tidal currents, mangrove vegetation, salinity gradient, diurnal temperature variation etc. and huge land runoff carrying huge sediments from its catchment area and human habitations.

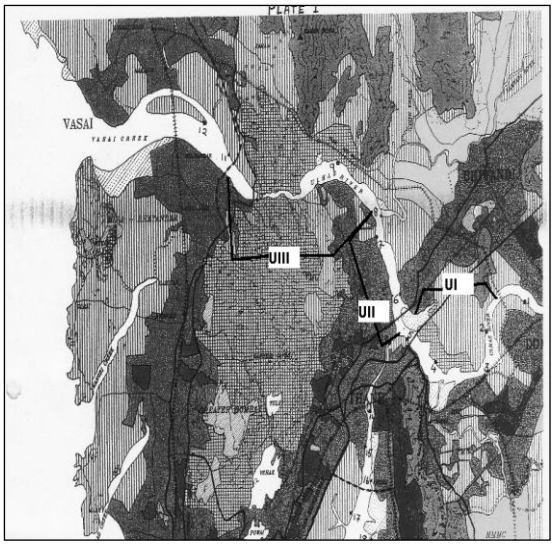

Fig. 1. Map showing the Ulhas river estuary (Lat 19^o 16' N and longitude 72^o 45'E).

There are number of industries situated along the either banks of the river, adding their effluents at various localities namely Ambivli, Ulhas Nagar, Dombivli, Bhiwandi and Thane City and loading the water body with pollutants heavily. A considerable load of the sewage from Thane city is also added affecting aquatic organisms (Lala, 2004, Athalye *et al.* 2003, Mishra, 2002, Zingde, 2002, Mohapatra *et al.*, 2000, Tandel, 1886, Patil, 1982 Metcalf *et al*., 1979, Durve *et. al.*, 1961), particularly in UI. The fisheries of the estuary have been dwindling to the threatening status (Rathod *et al.*, 2002, Mutsaddi, 1964). Therefore, monitoring water parameters regularly can help in assessing the extent of pollution and planning the remedial measures.

Table 1. Monthly variation in water parameters. (MON= Monsoon; EPM= Early post-monsoon; LPM= Late post-monsoon and PRM= Pre-monsoon).

YEAR▼		HP►	Water Temperature (C)			Light Penetration (cm)			Suspended solids (gm/l)			pH (units)			Salinity (ppt)		
		Sta.►	KS	GS	VS	KS	GS	VS	KS	GS	VS	KS	GS	VS	KS	GS	VS
2004	MON	JULY	27	27	**25**	5	7	7.5	**0.7**	3	1.2	6.71	7.31	7.79	**0.04**	**0.05**	**0.1**
		AUG	27	26	25.5	**5**	2	**2.5**	3	5.6	5	7.86	7.8	7.31	0.4	1.9	8.1
		SEPT	28	29	29	**5**	**1.5**	**2.5**	6	4	8	8.07	6.71	7.91	1.9	12.9	15.3
	EPM	OCT	27	**25**	**25**	23	**36**	**38**	2.8	**14.2**	11.4	7.16	7.14	7.25	14.2	23.7	25.4
		NOV	26	**25**	**25**	**28**	13	10	1.6	14	**15**	7.21	7.6	7.28	22.8	24.5	25.8
		DEC	**24**	**25**	**25**	20.5	9	11	2.4	4	1.6	7.61	7.08	6.53	22	24.2	25.4
2005	LPM	JAN	24.5	**25**	25.5	27.5	6	5	2	2.8	**0.4**	7.41	7.28	**6.51**	17.5	23.4	23.8
		FEB	26	**25**	**25**	19	13.5	8.5	1.6	1.8	**0.4**	**6.59**	**6.24**	6.82	20.8	27	31.4
		MAR	31	29	29	26.5	5	8	**6.2**	11.8	1.2	7.41	7.75	7.76	22.6	23.4	31.5
	PRM	APR	33	32	**33**	19	14	11	1	1	0.6	7.42	7.23	7.91	20.9	**27.1**	28.7
		MAY	33	32	32	9	22	18	1.8	**0.4**	0.6	**8.82**	**8.01**	7.92	**23.4**	32.3	**32.4**
		JUN	**33.5**	32	30	9	22	18	1.2	1	1.2	7.53	7.55	**7.97**	20.7	24.2	29.3
YEAR▼		HP►	DO mg/l			BOD mg/l			PO_4-P (mg/l)			NO_3-N (mg/l)			SiO_3-Si (mg/l)		
		Sta.►	KS	GS	VS	KS	GS	VS	KS	GS	VS	KS	GS	VS	KS	GS	VS
2004	MON	JULY	3.5	3.2	3.6	1.7	0.8	1.6	0.25	0.16	**0.5**	7.2	4.9	10.9	9.6	67.6	**93.3**
		AUG	3.4	3.3	1.5	**0.5**	**0.4**	**0.4**	0.35	0.25	0.29	20.6	8.7	13.3	**91.3**	**77.7**	48.1
		SEPT	0.9	1.2	**0.6**	7.3	1.8	2.4	0.34	0.34	0.1	**1.4**	**0.8**	3.6	69.5	50.3	48.4
	EPM	OCT	**4.1**	2.5	2.5	18.8	1.2	2.4	0.11	0.09	0.09	12.2	1	**1.1**	14.6	14.7	16.2
		NOV	2	3.4	1.7	8.8	4.2	1.2	0.07	**0.07**	**0.06**	13.8	4.3	6.1	11.4	21	18.4
		DEC	0.7	**0.8**	3.2	6.1	1.8	1.6	0.1	0.07	0.22	15.2	5.4	5	8.6	30	16.4
2005	LPM	JAN	0.9	1	1.2	13.9	7.9	15.8	**0.04**	0.1	0.17	5.4	5.5	4.1	12.2	15	19.6
		FEB	**0.5**	1.3	1.4	4	3	**31.3**	0.23	0.48	0.25	21.6	20.5	13.6	16.6	24.2	14
		MAR	2.9	**6**	**7**	7.1	**30.5**	14.1	**0.4**	0.32	0.35	**35.8**	**33.5**	**28.9**	16.2	26.3	27.8
	PRM	APR	1.4	1.2	3.1	**28.5**	5.1	18.2	0.22	0.49	0.23	11	7.7	7.8	**6.4**	21.3	18
		MAY	3.4	1.8	2.2	9.1	2.7	3.6	0.18	**0.49**	0.34	9.1	8.5	7.7	6.8	**7**	**8**
		JUN	1	2	3.3	10	4.5	5.7	0.17	0.34	0.25	5.4	7	5.6	38.8	32.5	28.9

Material and methods :

The hydro-sedimentological studies were performed at three stations viz. Kharegaon (KS), Gaimukh (GS) and Versova bridge (VS) from their corresponding zones (UI, UII & UIII) (Fig.1) on monthly basis from July 2004 to June 2005 divided into seasons as Monsoon (MON) - July to September; Early Post Monsoon (EPM) - October to December; Late Post Monsoon (LPM) - January to March and Pre-monsoon (PM) - April to June. Surface water samples were collected between the 2nd and 3rd week of every month during full tide and following parameters were analysed, using methods as per **APHA, AWWA, WPCF** (1981) (table-2)

Table 2. Methodology :

Parameter	Method of assessment
Water temperature (^oC)	Alcohol thermometer (0 – 110 ^oC)
Light penetration (cm)	Secchi disc of diameter 20cm.
Suspended solids (g/l)	Evaporation at 70^oC.
pH	'Systronics' pH Meter
Salinity (ppt.)	Argentometric method
Dissolved oxygen (mg/l)	Winkler's method
Biochemical oxygen demand (mg/l)	Winkler's method
Phosphate-phosphorus (mg/l)	Ammonium molybdate method
Nitrate-nitrogen (mg/l)	Phenol disulphonic acid method
Silicate-silicon (mg/l)	Molybdo-silicic acid method

Results and discussion:

Water temperature plays an important role in the estuaries. The endemic organisms being eurythermic can tolerate the temperature fluctuation but the occasional visitors are greatly affected. Temperature fluctuation also affects the phytoplankton and zooplankton and hence affects the fish population. Due to the shallowness of the basin and influx of the river, the temperature varies diurnally and seasonally.

In present study the surface water temperature ranged from 24^{o}C to 33.5^{o}C in the Ulhas river estuary. The temperature rises gradually from early post monsoon to the late post monsoons throughout the estuary. The average water temperature exhibited mild gradient from riverine side to seaward (table 1).

The light penetration (LP) has importance regarding the primary productivity of the ambient water. Being shallow the light can reach the bottom but due to suspended solids (SS) it is greatly obliterated and hence affects the photosynthesis. The SS may be the plankton or other particulate matter. Certain other factors like turbulence, run-off water, domestic and industrial wastes, mining or dredging activity increase the particulate matters.

LP ranged between 1.5 cm. and 38 cm. in present study (table 1). UII and UIII were at minima whereas UI at maxima in light penetration as it is diluted due to riverine clear water (Table 1). Increased turbidity in UII and UIII was also due to frequent sand dredging activity in UII (Mishra, 2002).

Present attempt has revealed the fluctuation in suspended solids between 0.4 gm/l and 15.0 gm/l (table 1). However the very high average (Fig.2) SS (above 1gm/l) indicated the polluted state of the estuary.

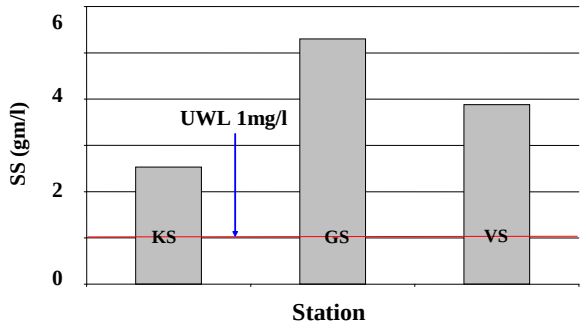

Fig. 2. Stationwise average SS in URE (2004-05).

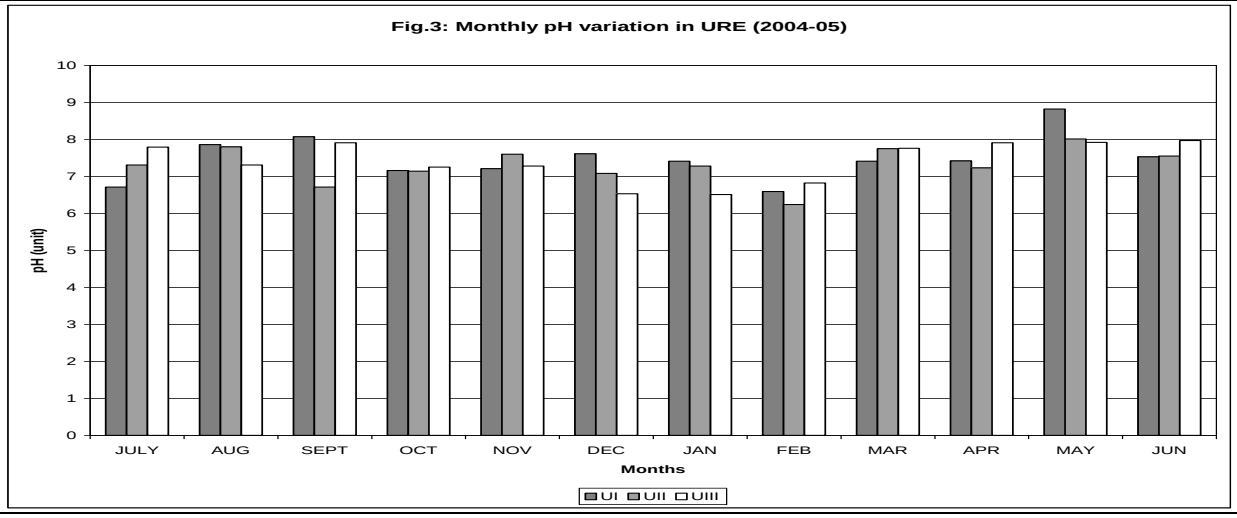

Fig. 3. Monthly pH variation in URE (2004-05)

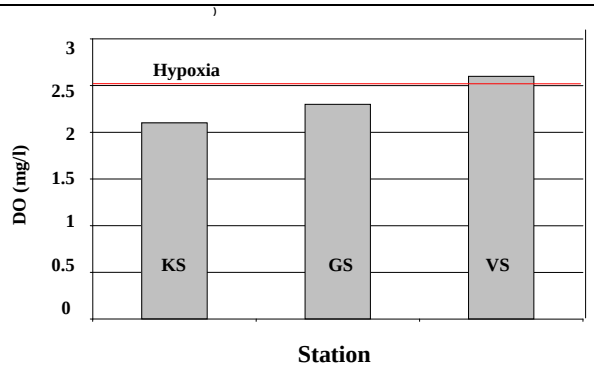

Fig. 4. Stationwise average DO in URE (2004-05).

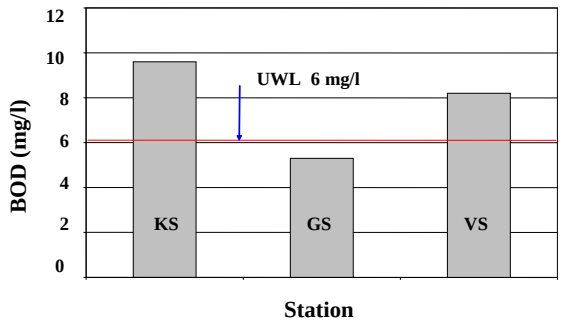

Fig. 5. Stationwise average BOD in URE (2004-05).

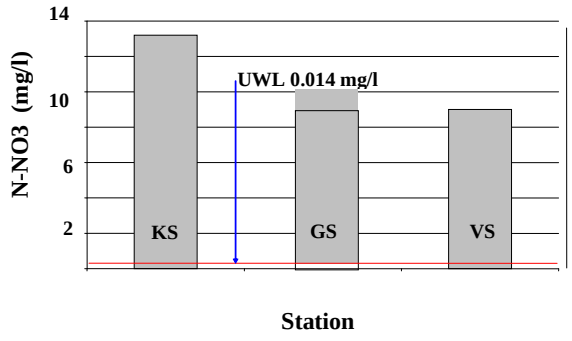

Fig. 6. Stationwise average nitrates in URE (2004-05). UWL = Unpolluted Water Limit

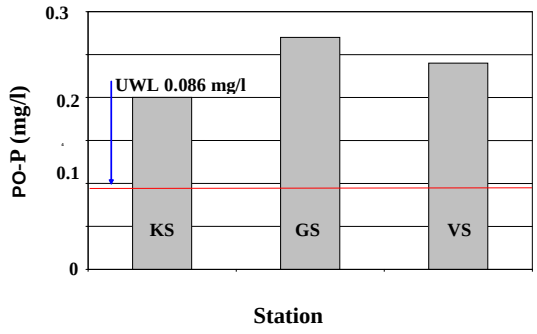

Fig. 7. Stationwise average phosphates (2004-05). UWL = Unpolluted Water Limit

The pH ranged from 6.24 to 8.82 (Table 1) during the study period. pH dropped to slightly acidic from the month of December, 2004 to February and March, 2005 (Table 1) and kept fluctuating irrespective of the seasons in the entire stretches of the estuary (Fig.3). This must be due to wastes added intermittently; from the industries and domestic area in the vicinity. The pH variation must be exerting heavy stress on the inhabitant organisms in the estuary (Clayton, 1993).

Water salinity plays a crucial role in the estuarine habitat as it often fluctuates with the oceanic tidal

inundation and the river water influx. Ulhas River estuary is very shallow and hence is affected largely due to both the tidal and riverine currents. Euryhaline endemic organisms are not much affected due to the salinity fluctuation but some being very sensitive to it cannot withstand the dilution due to sewage water disposal or release of dam water, up-streams.
The salinity varied greatly from 0.04 $‰$ (negligible) to 32.4 $‰$ (Table 1). Salinity was very unstable in UI.

Dissolved oxygen (DO) plays an important role in aquatic environment like estuary. The inhabitant organisms are affected greatly due the diurnal and seasonal variation in the dissolved oxygen of the ambient water. DO is governed by the water turbulence, surface diffusion, rate of photosynthesis, BOD, water temperature and carbon dioxide concentration.

In the present study DO ranged between 0.5 mg/l and 7.0 mg/l. However dissolved oxygen on an average remained hypoxic (January05 to June05 being critical) throughout the year in all the zones (Fig.4) indicating that the estuary is highly polluted. (Laponite *et al*, 1992).

Biochemical oxygen demand (BOD) is a measure of the organic matter present in the ambient water. BOD increases with the increased inflow of the domestic waste (Athalye *et al.,* 2003). High BOD depletes the oxygen level to a critical condition thus indicating the pollution status of waters.

BOD of Ulhas River estuary ranged from 0.4 mg/l to 31.3 mg/l (table 1). BOD increases to its greatest in the LPM season indicating the high pollution. BOD was relatively low at GS as compared to KS and VS (Fig. 5) indicating the high organic deposition in UI and UIII through domestic and industrial wastes as there are more human settlements nearby.

The nutrients play a major role in primary productivity of the estuary. These are generated as a result of decomposition in natural condition that is regularly taken up by the phytoplankton in an aquatic body. However the industrial effluents and domestic waste also carry excessive nutrients like NO_3-N and PO_4-P indicating high pollution in the habitat.

The SiO_3-Si is brought in by riverine water; due to leaching of the basin as a result of affinity to oxygen or sources like igneous rock of volcanic origin as it is seen in Ulhas river estuary (Mishra, 2002). Silicates are important for growth of diatoms imparting primary productivity but not essential to be very high in concentration.

The silicate-silicon values are very elaborate during monsoon and it ranged from 6.4 mg/l to 91.3 mg/l (Table 1) probably due to runoff water carrying silicates to the water body. It gradually decreases as it leads to PRM.

Nitrate is an essential nutrient but also a good indicator of contamination from natural and human activities. Sources include manures, inorganic fertilizer and on-site sewage disposal systems. Levels above 5 mg/l are considered harmful to aquatic organisms. The nitrates were ranging from 0.8 mg/l to 35.8 mg/l (Table 1) in the present finding. The average nitrates were found to be extremely high as compared to the tolerable limits in all the zones (Fig.6).

Phosphorus is an essential nutrient present in soil and water in inorganic and organic forms. Sources can include urban or industrial wastewater and applied soil nutrients such as inorganic fertilizer, manure or sewage sludge. Manure applications based on nitrogen requirements can result in excessive phosphorus application and the potential for runoff. The phosphate-phosphorus is added to the estuary from the domestic sewage. Land runoff increases the phosphorus during the monsoon (Qasim *et al.,* 1969).

Phosphorus ranged from 0.04 mg/l to 0.5 mg/l (Table 1).

Both Nitrate-nitrogen and phosphate-phosphorus values are very high (Fig.6 & 7) with the elevations in MON and LPM (Table 1). In monsoon nutrients

are brought in by the rain water from the catchment area whereas in LPM, it is attributed to certain anthropogenic activity which corroborates with the high BOD of present study. Similar results were recorded by Mishra (2002) in Ulhas river estuary.

Conclusions :

- High SS, BOD and nutrients and hypoxia indicate that entire estuary has deteriorated.
- U I being greatly affected due to human habitation, shallowness and riverine influx. However all three zones UI, UII and UIII are inclined towards high pollution.
- indiscriminate exploitation in future to save the natural heritage of our township.

Overall scenario of the Ulhas River estuary pollution status during the study period indicates that the estuary is affected to its threshold limit and must be protected from

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