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Original Research Paper

Seasonal Variation in Some Metals of Inshore Waters of Malvan, Maharashtra

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ABSTRACT

Metals were investigated at Tarkarli, Kolam and Aachara estuary of Malvan, Maharashtra under low tide situation in different seasons. Ni, Cu, Pb and Mn were observed nil during monsoon season, while Fe and Mg were in high range. Na, Ca and K were low during rainy season and constant during summer and winter seasons. Lower values of all the metals during monsoon season suggest that the freshwater influx in the estuary can be the main influence on the water quality.

INTRODUCTION

Water is one of the important constituents of life support system. It is indeed a wonderful chemical medium, which has unique properties of dissolving and carrying in suspension of huge varieties of material with different chemical properties. Water helps in the movement, circulation and cycling of nutrients in the biosphere. Water is one of the most important commodity which man has exploited than any other resource for the sustenance of his life. Thus, it can get contaminated very easily. Water resource is under threat due to over-utilization from modern society, industrial and domestic sectors. Due to industrialization and misuse by man himself, water is now being rapidly polluted.

Coastal ecosystems are under threat due to anthropogenic activities, increased human settlement, agricultural waste, and the progressive industrialization and tourism business. The ever-increasing human population, urbanization and industrialization around the coastal ecosystems result in irrational use of estuarine environment (Chattopadhyay & Kushari 2003). Coastal ecosystems such as estuaries, coral reefs and mangrove forests are highly valuable for coastal communities and much of the world's wealth of biodiversity is found highly diverse (Chabrie et al. 2001). An estuary is typically tidal 'brain' of a river and often characterized by sedimentation or silt carried in from terrestrial runoff and, frequently from offshore (Daiber & Beattie 1969). An element or compound present in a natural water system will generally distributed between a variety of physico-chemical status (Burton 1979).

Metals are naturally occurring elements but sometimes their concentration gets increased due to human activities. Elements in some proportion are important for human beings and aquatic life, and also for normal growth and development. It is important in water management to know concentrations of various constituents of water. The inshore line of India, especially Konkan area, is under threat due to effluent discharge from small scale industries and pesticide leaching from agricultural fields. Malvan is also known for Sindhudurg fort, coral reefs, dunes and more fish catch. Estuaries of Sindhudurg district are more productive in nature. Coastal zone has different biotopes as estuaries, mangroves, coral reefs and lagoons endowed with splendid beauty and high productivity. Variety of fishes, crustaceans and molluscan animals are found in large quantity. Inshore coast of Malvan is

under threat of pollution and coexistence of estuaries threatened by the rapidly growing tourism and tourist flow. Improper disposal facility and unawareness about water quality are associated impact on aquatic life and surrounding environment. Human settlement and number of hotels are growing in and around Malvan coast. Solid and liquid wastes are directly dumped into estuaries will be changing quality of water continuously. It is observed that there is fragmentary information on estuary water quality, particularly from the Tarkarli, Achara and Kolam estuaries. Therefore, the present study was undertaken.

MATERIALS AND METHODS

Water samples were collected seasonally for the full year from November (2006) to October (2007) at three locations of Tarkarli, Kolam and Aachara estuaries under low tide condition. Sites were selected as upstream and downstream. Surface water samples were collected in well-washed sampling bottles and kept in refrigerator. Heavy metals were detected by Perkin Elmer Atomic Absorption Spectrophotometer (AAS). Results presented in the water analysis from selected estuaries are the mean of 3 samples with standard deviation ($X \pm S.D.$). The Student's *t*-test was used for determining the significance of the mean values of different parameters. The level of significance was set at $p < 0.05$ considering 5% error. The Student's *t*-test was also used for determining the significance of difference between the upstream and downstream site.

RESULTS AND DISCUSSION

Variations in different parameters during the period of observation are given in Tables 1 to 3 and Figs. 1 to 3.

Heavy metal estimation shows that different elements prove their existence under influence of water flow. The toxic heavy metals were found almost negligible, which proves that no heavy metal being released by industrial source from near the selected area. The elements were constant during winter and summer but rainy season showed fluctuation, while some were increased due to water flow.

Presence of large number of heavy metals in ecosystems and their toxicity manifestation, ranging from mildly harmful to lethal has been reported by several researchers (Fugare et al. 2004). Lower values of heavy metals like 0.05 mg/L copper, 0.1mg/L lead and 0.4 mg/L zinc were seen in Crossica river. In Cochin backwater iron and nickel were constant at surface whereas the metals like copper, zinc and manganese showed spacial variation. Seasonal variations were maximum during August to December, which remained almost uniform for all the metals (Sarladevi et al. 1991).

Copper, iron and magnesium were found more at upstream site. They were observed more during rainy season due to high siltation. The metals copper and zinc were more towards upstream site due to sources like domestic and agriculture. Lead, nickel and zinc were found to be constant during summer and winter, and negligible during monsoon season. Sodium, potassium and calcium were found in increasing order at upstream of all sites respectively. This may be due to increasing seawater flow towards upstream. Laluraj et al. (2002) showed that bottom waters have higher concentration of calcium than that of surface waters due to dissolution of detritus material taking place during the premonsoon season as found in Kayamkulam estuary. Ca and K concentration was highest in estuarine region due to the more influx of riverine source (Chahan & Ramnathan 2008).

The distribution of total and dissolved manganese in estuaries is usually nonconservative (Rich-

Table 1: Seasonal variation in metals during winter season at three locations in the estuaries.

Sr. No.	Elements	Achara		Kolam		Tarkarli	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
1	Cu	0.047±0.07	0.059±0.0021	0.099±0.011	0.0111±0.03	0.98±0.22	0.114*±0.015
2	Fe	0.022±0.02	0.012±0.0011	0.21±0.001	0.23±0.11	0.087±0.045	0.168*±0.12
3	Mg	430±1.2	390**±12.3	544.36±24.2	619.3*±42.3	524±12.2	416±65.2
4	Mn	0	0	0.04±0.03	0.021*±0.0012	0.0444±0.02	0.26*±0.012
5	Ni	0.05±0.02	0.08±0.02	0.012±0.0015	0.69.8*±0.045	0.091±0.004	0.183*±0.012
6	Pb	0.074±0.011	0.08±0.004	0.044±0.011	0.021±0.02	0.136±0.011	0.32**±0.11
7	Zn	0.164±0.022	0.259*±0.11	0.055±0.0015	0.066±0.0012	0.174±0.089	0.181±0.99
8	Na	1290±22.3	3987*±55.4	1560±12.3	2789*±111.2	1980±22.3	3780.3*±113.5
9	K	231.3±1.5	560.6*±22.1	650±56.3	333**±12.3	754±12.2	218**±23.
10	Ca	238.8±41.2	430*±11	360.12±22.3	122.3**±44	506.7±9.8	231.7**±8.2

Values are expressed in mg/L, Mean ± SD; *significantly increased; ** significantly decreased

Table 2: Seasonal variations in metals during summer season at three locations in the estuaries.

Sr. No.	Elements	Achara		Kolam		Tarkarli	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
1	Cu	0.22±0.11	0.032**±0.02	0.078±0.22	0.088±0.03	0.024±0.01	0.051±0.22
2	Fe	0.055±0.15	0.025±0.01	0.161±0.12	0.164±0.12	2.876±0.88	2.376±1.1
3	Mg	974±112	382.4**±45.2	612.8±32.3	928*±45.3	0.269±0.11	0.221± 0.055
4	Mn	0.00716±0.15	0.0395*±0.025	0.0418±0.032	0.0538±0.022	0	0
5	Ni	0.06±0.04	0	0.55±0.14	0.86*±0.112	0.074±0.004	0.067±0.04
6	Pb	0.225±0.112	0.452*±0.23	0.395±0.22	0.376±0.11	0	0
7	Zn	0.074±0.014	0.055±0.01	0.08±0.07	0.074±0.045	0.02±0.01	0.029±0.010
8	Na	2497.9±321.2	3973.8*±12.3	1459±62.3	2090*±12.5	2690.5±2.0	3810.1*± 2.1
9	K	425.1±82.2	307.1±3.3	225.3±33.3	205.9±35.4	285.1±14.2	208.5**±12.3
10	Ca	315.2±66.2	307.6±45.6	70.4±12.3	188.5*±15.6	221.9±61.2	252.3*±32.5

Values are expressed in mg/L, Mean ± SD; *significantly increased; ** significantly decreased

Table 3: Seasonal variations in Heavy metals during rainy season at three locations in the estuaries.

Sr. No.	Elements	Achara		Kolam		Tarkarli	
		Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
1	Cu	0.02±0.001	0.052*±0.044	0.027±0.011	0.02±0.001	0.024±0.004	0.051±0.011
2	Fe	2.1±0.99	3.074±0.88	3.035±1.1	1.172**±0.12	2.876±0.0045	2.376±1.1
3	Mg	0.329±0.12	0.23*±0.088	0.251±0.25	0.30**±0.11	0.269*±0.025	0.221±0.01
4	Mn	0	0	0	0	0	0
5	Ni	0	0.092*±0.055	0.053±0.011	0.041±0.001	0.074±0.0045	0.0670
6	Pb	0	0	0	0	0	0
7	Zn	0.011±0.55	0	0.014±0.07	0	0.021±0.0012	0.029±0.0014
8	Na	419.3±56	610.3*±21.3	919±65.2	1912*±22.3	210±12.3	523.2*±22.3
9	K	101±23.1	193.2*±100	158.9±25.6	102.3**±21.2	89±8.8	199*±15.8
10	Ca	251±45.2	320.3*±10	122.3±9.5	104.3**±9.8	155.6±14.3	174.4*±16.3

Values are expressed in mg/L, Mean ± SD; *significantly increased; ** significantly decreased

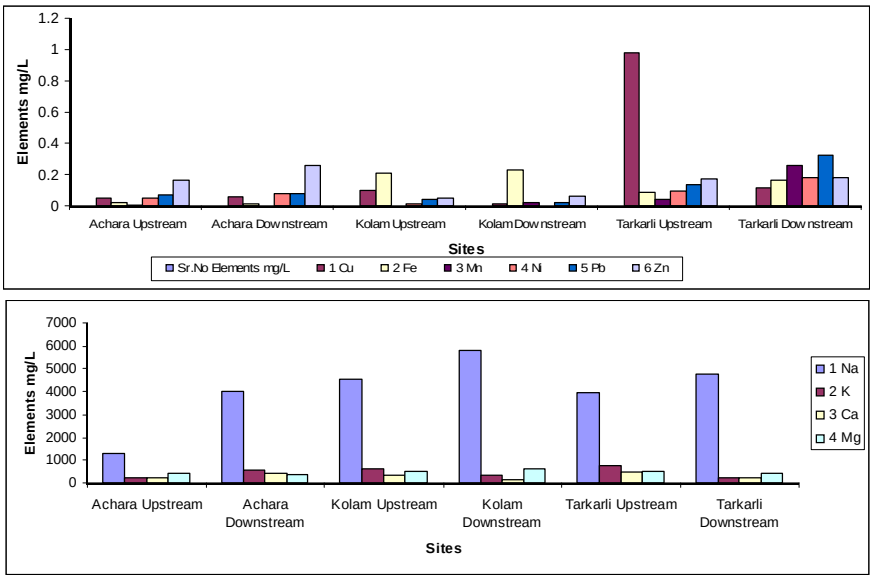

Fig. 1: Seasonal variation in metals at three locations in the estuaries in and around Malvan (winter season).

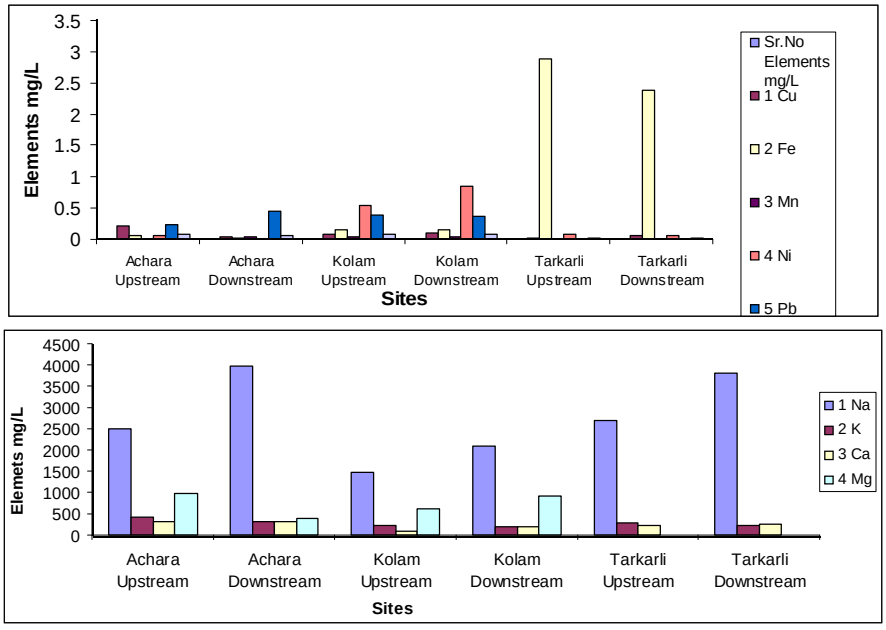

Fig. 2: Seasonal variations in metals at three locations in the estuaries in and around Malvan (summer season).

ard 1989) but its limiting supply for estuarine biological process is specific (Evans 1977). Mercury concentrations of 60 µg/g have been reported in the sediments of interior in Ulhas estuary (Pradhan et al. 1999). Zinc concentration in the estuaries is only due to human activities in and around estuary (Kumari et al. 2005). The levels of iron, zinc and copper showed a slight seasonal fluctuation with

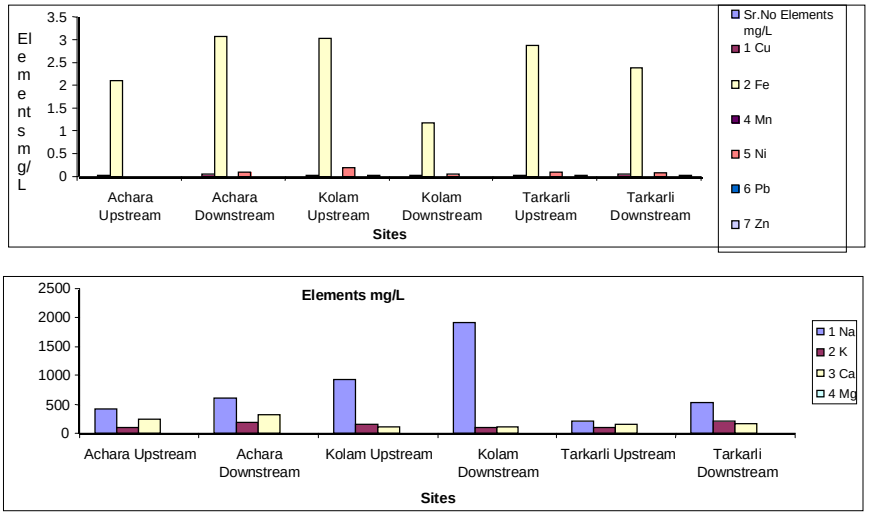

Fig. 3: Seasonal variations in metals at three locations in the estuaries in and around Malvan (rainy season).

higher concentration during the monsoon months in Ennore estuary and the concentration of iron, zinc, manganese and copper in water exceeded (Rajathy 1997).

It clear that metals prominently present at upstream were very less towards downstream. The element found at upstream may be due to natural or anthropogenic activities. It gets clear from these investigations that at Tarkarli estuary inflow of freshwater is high. Achara estuary showed almost all the heavy metals constant. All the parameters showed higher variation during rainy season, which makes it clear that seasons have their impact on metals. Considering all these, it can be said that tourism has some influence on heavy metal concentration. Heavy metals showed constant values during rainy season. Heavy metal including Cu, Ni, Zn and Pb increased at downstream site. Sodium and potassium were found to be higher towards upstream site. It can be concluded that all the metals are in a particular range and varied seasonally. Metals found at upstream site are at their extremes and can be harmful to aquatic life.

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