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STUDIES ON THE HEAVY METAL DISTRIBUTION IN THE SEDIMENTS OF ADIRAMPATTINAM MANGROVE REGION, TAMIL NADU, INDIA

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ABSTRACT

The present study was carried out for a period of 12 months *i.e.* from July 2010-June 2011. For the present study two sampling stations were fixed *viz.,* Adirampattinam mangrove waters (Station I) and Adirampattinam coastal waters (Station II). The heavy metal concentration in sediments of the present study such as (Cd, Cu, Zn, Fe, Pb, Cr and Mn) showed spatio-temporal variation between the two stations (St-I and St-II). It also exhibited high values observed during the monsoon season and low values during the summer seasons. Heavy metals in sediments showed high values in coastal waters at Station II, while they exhibited low values are in Mangrove waters at Station I. Because mangroves act as phytoremediation process which is capable of trapping (accumulation) heavy metals to remove pollutant from contaminated soil without carrying any significant effect to vegetation. In mangroves soil system, strong absorption and fixing of heavy metals by soil easily accumulated in the soil, resulting in water absorption of heavy metals by growing plants.

INTRODUCTION

The mangroves have also significant roles in the maintenance of coastal water quality, reduction of the severity of coastal storms, waves and flood damage, nursery and feeding grounds for fishery resources. The water quality problems of the coastal environment are significantly different from those of the freshwater environment. The coastal water has undergone varying severity of the chemical changes due to human activities like terrestrial drainage, atmospheric deposition and urban discharges (Valdes and Real, 1998). Coastal pollution has seriously affected the exploitable living resources reduction in coastal biological diversity, recreational and commercial uses and overall integrity of coastal ecosystem.

Heavy metals are considered as major resources of pollution in natural water (Govindasamy *et al.*, 1998). These have received considerable attention because of the inherent toxicity to the living aquatic forms. The toxicity of heavy metals in water in affected by pH, hardness, alkalinity and organic materials (Prabhahar *et al.*, 2011). Another type of toxic pollution comes from heavy metals such as cadmium, mercury and lead. Recently, a high toxic chemical called TriButylTin (TBT) is used in paints to protect boats from the ravaging effects of the ocean. Mineral, containing heavy metallic elements are of widespread occurrence in rocks and soils, when they weathered, cations of the heavy metals are liberated and find their may into surface waters and soil waters. Lead, copper and zinc have been extensively mined and whose environmental levels have been strongly influenced by man all are toxic to living animals and are considered as serious pollution (Zafar Ayas *et al.,* 2006).

In aquatic ecosystem metallic compounds occur in low concentration. Heavy metals may come from natural sources, leached from rocks and soils according to their geochemical mobility and also from anthropogenic source as the result of human land occupation and industrial pollution (Prabhahar *et al.,* 2011). Depending on their solubility, these metals may be eventually associated with suspended particulate matter or accumulate in the bottom sediments. The increase of industrial activities has intensified environmental pollution problems and the deterioration of several aquatic ecosystems, with the accumulation of metals in the target organs. Trace elements are essential to life but at high concentration may become hazardous. Heavy metals such as cadmium, arsenic and lead can cause several problems in aquatic environments due to their persistence, toxicity and tendency to accumulate in tissue (Sywayer *et al.,* 2003).

MATERIALS AND METHODS

Sediments samples were collected on a monthly basis in the both stations by using a Petersen's grab sampler for one consecutive year. The samples were taken from the mid portion of the grap to avoid the metal contamination and brought to the laboratory in clean polythene bags.

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The collected samples were using pestle, Mortar and ground to fine powder dried in a oven at 60ºC for 24hrs. One gram of powder sample was digested with hydrochloric acid and nitric acid-perchloric acid (HCl, HNO_3, and HCl_4) mixture at a ratio of 10:5:1 (25, 12.5, 2 ml) at 300ºC following the method of Guzmann and Jimenez (1992) the digested residues were dissolved and filtered. A small aliquot was injected into Atomic Absorption Spectrophotometer (AAS) Perkin Elmer Model A400 the quantified values for Iron, Zinc, Lead, Manganese, Cadmium, Chromium and Copper the values are expressed in ug/g.

RESULTS

The Copper value at station I varied from 1.29 to 0.23↘g/g. The minimum was recorded as 0.23↘g/g (June). The maximum was recorded as 1.29↘g/g (Dec.). At station II the copper value varied from 1.68 to 0.46↘g/g. The minimum was recorded as 0.46 ↘g/g (June). The maximum was recorded as 1.68 ↘g/g (Aug.).

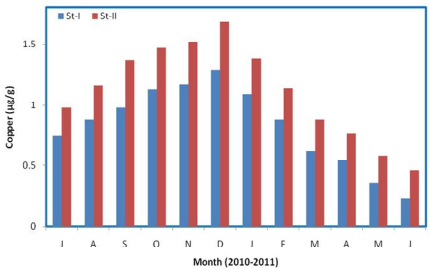


Fig.1 Monthly variation in Copper concentration in water recorded at stations I and II from July 2010 to June 2011

The Zinc concentration at station I varied from 2.04 to 0.23↘g/g. The minimum was recorded as 0.23↘g/g (June). The maximum was recorded as 2.04↘g/g (Nov.). At station II the Zinc concentration varied from 2.41 to 0.35↘g/g. The minimum was recorded as 0.35ug/g (June). The maximum was recorded as 2.41 ↘g/g (Nov.).

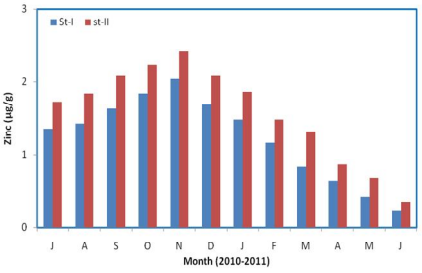


Fig.2 Monthly variation in Zinc concentration in sediment recorded at stations I and II from July 2010 to June 2011

The Cadmium concentration at station I varied from 1.58 to 0.32 ↘g/g. The minimum was recorded as 0.32 ↘g/g (June). The maximum was recorded as 1.58 ↘g/g (Nov.). At station II the Cadmium concentration varied from 1.82 to 0.46 ↘g/g. The minimum was recorded as 0.46 ↘g/g (June). The maximum was recorded as 1.82 ↘g/g (Nov.).

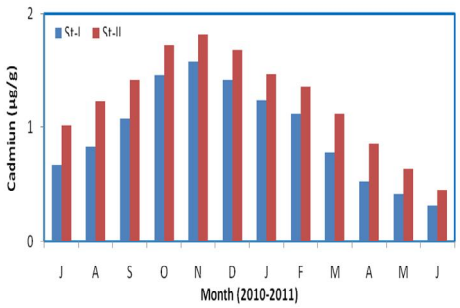


Fig.3 Monthly variation in Cadmium concentration in sediment recorded at stations I and II from July 2010 to June 2011

The Lead concentration at station I varied from 1.18 to 0.54 ↘g/g. The minimum was recorded as 0.54 ↘g/g (June). The maximum was recorded as 1.18 ↘g/g (Nov.). At station II the Lead concentration varied from 1.31 to 0.58 ↘g/g. The minimum was recorded as 0.58 ↘g/g (June). The maximum was recorded as 1.31 ↘g/g (Nov.).

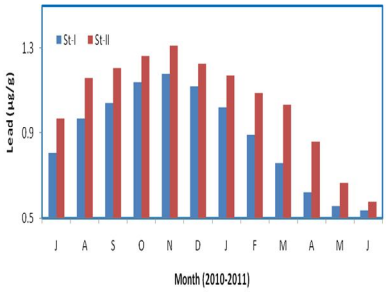


Fig.4 Monthly variation in Lead concentration in sediment recorded at stations I and II from July 2010 to June 2011

The Iron concentration at station I varied from 1.26 to 0.11 ↘g/g. The minimum was recorded as 0.11 ↘g/g (June). The maximum was recorded as 1.26 ↘g/g (Dec.). At station II the Iron concentration varied from 1.38 to 0.28 ↘g/g. The minimum was recorded as 0.28 ↘g/g (June). The maximum was recorded as 1.38 ↘g/g (Dec.).

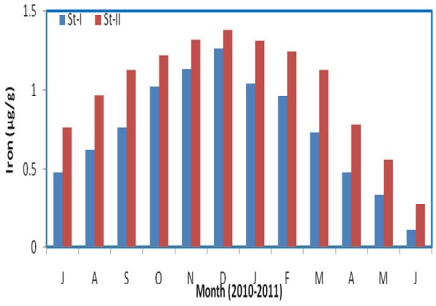


Fig.5 Monthly variation in Iron concentration in sediment recorded at stations I and II from July 2010 to June 2011

The Chromium concentration at station I varied from 1.28 to 0.26 ↘g/g. The minimum was recorded as 0.26 ↘g/g (June). The maximum was recorded as 1.28 ↘g/g (Dec.). At station II the Chromium concentration varied from 1.38 to 0.36 ↘g/g. The minimum was recorded as 0.36 ↘g/g (June). The maximum was recorded as 1.38 ↘g/g (Dec.).

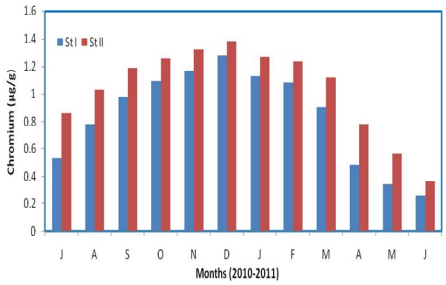
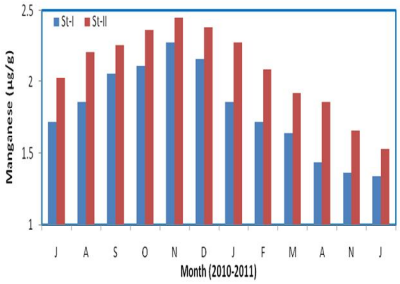


Fig.6 Monthly variation in Chromium concentration in sediment recorded at stations I and II from July 2010 to June 2011

The Manganese concentration at station I varied from 2.28 to 1.34 ↘g/g. The minimum was recorded as 1.34 ↘g/g (June). The maximum was recorded as 2.28 ↘g/g (Nov.). At station II the Manganese concentration varied from 2.45 to 1.53 ↘g/g. The minimum was recorded as 1.53 ↘g/g (June). The maximum was recorded as 2.45 ↘g/g (Nov).



DISSCUSION

Concentration of heavy metals such as Copper, Zinc, Cadmium, Lead, Iron, Chromium and Manganese occur in marine seawater in different forms and in different concentrations. Heavy metals can enter in to the aquatic ecosystems, industrial effluents, anthropogenic wastes or even from acidic rain, breaking down of soils and releasing heavy metals into streams, lakes, rivers and ground waters (Misra *et al.*, 1992).

Copper concentration was maximum during the monsoon seasons and minimum during the pre-monsoon. Such a seasonal variation of Cu concentration in sediments perhaps was due to the presence of major sources of metal pollution, intensive of human activity. All over the world discharge of domestic wastes and land run-off reaching the coastal area and also industrial effluents, sewage outlets and municipal wastes. (Praphahar *et al.*, 2012). Phytoplankton activity might have also facilitated the seasonal variation in Cu as this metal is an essential one for phytoplankton.

Zinc concentration was high during the monsoon at both stations. High Zn concentration in water could have resulted due to the release of this metal from the sediments and abundant organic matter (Pragatheeswaran *et al.*, 1988). Zn Concentration was low concentration during the summer season at both the stations. This would have resulted due to the utilization and uptake of Zn along with other nutrients by the biota including phytoplankton. Bruland and Franks (1983) have also established that Zn could get strongly depleted from the surface waters as it has a nutrient type of distribution in seawater.

Cadmium concentration was more during the monsoon at the both stations less during the summer season at both the stations. According to Senthilnathan (1990) Cd is released into the atmosphere by fossil fuel and by the burning of agricultural and municipal wastes, including dried sewage sludge.

Lead concentration was more during the monsoon in both stations due various sources of pollutions paints diesel fuel combustions pipes and solder discarded batteries and natural deposits. Lead reduces mental capacity, inference with Kidney and neurological functions, hearing loss, blood disorders, hypertension and death may due to high level (Lark *et al.*, 2002).

Iron-concentration was more during the monsoon season in stations due to various sources of pollution leaching of cast iron pipes in water distribution system and by natural process. The effects of iron is to brackish colour, rusty sediment, better or metallic taste, brown green strains iron bacteria and discoloured beverages (Kemdirim, 2000).

Chromium is highly toxic and responsible for several cases of poisoning through food. Small quantities of cadmium cause adverse changes in the arteries of human kidney. It replaces zinc biochemically and causes high blood pressures, kidney damage *etc* (Rajappa *et al.*, 2010). The sources of chromium pollution septic system industrial discharge and Geological mining sites both stations show chromium concentrations high in monsoon season. A number of toxic elements are introduced into the aquatic environment from the effluents discharged from the large industries resulting biodiversity and changes in water quality. For example effluents from textile mills and electroplating contained as much as 20-40ppm of chromium (Asthana and Meera Asthana, 2005).

Manganese concentration was more in monsoon season in both Stations the various source of pollution are land fill and deposition of rocks and soils. Topping (1969) analyzed dissolved trace metals (Mn, Cd, Cu, Fe and Zn) from the northern Indian Ocean and the Arabian Sea. Higher values of these trace metals were found in the surface layers when compared with the bottom, and exhibited a decreasing trend in their concentrations with depth. Except copper all other metals recorded higher values in inshore waters than in oceanic waters. An extremely low concentration of dissolved cobalt observed in northern Indian Ocean was attributed to its least occurrence in that area under certain conditions. Further, the author is of the opinion that the organic form of manganese in seawater plays a major role in its distribution in the marine environments (Pabhakar *et al.*, 2012).

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