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HEAVY METAL CONCENTRATIONS IN THE FIDDLER CRABS INHABITING THE ADYAR ESTUARY AND BACKWATER.

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INTRODUCTION

In India, there has been a growing awareness about the heavy metal pollution along the entire coast line in the last few years. However, baseline data on the concentrations of metals in the sediments, sea water and tissues of organisms and their effects on the physiology of organism and the ecosystem are very limited.

It has been estimated that about 7,75,000 litres of industrial effluents carrying heavy metal complement are discharged into the Adyar estuary every day. In addition, more than 225 million litres of untreated domestic sewage drains into the Adyar estuarine system enhancing the risk factor (Sornavel, 1978 ; Nammalwar, 1982 ; Tamilnadu water Supply and Sewage Board Report, 1982). Pollution induced mass fish kills have been reported in the Adyar estuary (Nammalwar, 1984). After the North-east monsoon period the river becomes either partially or fully detached from the sea by sand bank raised by breakers ; the Adyar backwater extends upto four kilometers into the city, the banks of which are virtually formed of all kinds of refuse right from waste paper onto the discarded automobiles, unused coaltar, woodshavings, animal and human excreta.

There has been a long felt need to study the ecological conditions of the Adyar estuary in relation to heavy metal pollution through a sentinel species and hence this work has been taken up.

Material and Methods

The experimental animal is the fiddler crab belonging to two species, *U.* (*C.*) *lactea* and *U* (*C.*) *tringularis* of the Adyar estuarine system.

For analysis of the sea water and sediments a 1% APDC (Ammonium pyrrolidine dithiocar bamate) was employed to chelate and IBMK (Isobutyl methyl ketone) to concentrate the metals at a pH of 2.2—2.8. The method prescribed in the FAO Fisheries Technical paper No. 137 was followed for atomic absorption spectrophotometry.

For estimating metal contents in animals, tissues from not less than 25 fiddlers were dissected and each type of tissue was pooled to arrive at one gram dry weight. The tissues were washed in demineralized water and dried in an oven at 120°C for 24 hours. The dry material was digested with 6N Nitric acid, followed by concentrated Nitric acid and then Perchloric acid or Hydrogen peroxide-Nitric acid mixture until the matrix became clear. The digested material was made up to the desired (25 ml) volume with 0.01 N Nitric acid. This was directly aspirated into the IL 457 Atomic absorption spectrophotometer and the concentrations of the metals were read directly under appropriate wave length recommended for each metal. Collection of material and laboratory analyses were done atleast once a month for a period of two years. The averages of multiple samples were considered to be nearer to the actual concentrations.

Results and Discussion

The ranges of occurrence of five heavy metals in the sea water, sediments and tissues are presented in Tables I,

Table 1. Heavy metal concentration ranges in the Adyar Estuary during 1982-1983

Nature of sample	Cd	Cu	Ni	Ph	Zn	
Sediments	BDL to 0.23	0.73 to 42.48	1.50 to 5.28	BDL to 10.63	1.46 to 45.00	μg/gm
Brackish water	BDL to 0.032	BDL to 0.352	0.011 to 0.195	BDL to 0.404	0.032 to 0.694	mg/lit

The concentrations of heavy metals did not fluctuate appreciably in the brackish water and Zn, Pb, Cu, Ni, Cd were in descending order. In the sediments there were significant fluctuations of Cu, Pb, and Zn indicating the differential sedimentation of these metals from water. The concentrations of all metals were more in the sediments when compared with the brackish water collected at any time of the year.

U. (C.) lactea annulipes inhabits sandy and sandy mud areas of the Adyar estuary while *U. (C.) triangularis bengali* inhabits muddy-clayey substratum. Ono (1965) indicated that the finer the particle size in the substratum, the more is the N-content leading to the growth of microbial organisms which maintain the food supply to the fiddlers. The sandy mud and clayey substrata of the Adyar backwater and some locations in the Adyar estuary which have richer populations of *triangularis bengali* show the presence of finer particles when compared with the sandy areas inhabited by *lactea annulipes*. Should heavy metal concentrations be more in the areas inhabited by *triangularis*, it will be reflected by the higher concentrations of these metals in the body of *triangularis*. Evidently it indicates the presence of heavy metals in higher concentrations in *triangularis*. Since males and females forage on the same sediments there are no appreciable differences in the concentration of these metals.

Table II. Average heavy metal concentrations in the *fiddler crabs* of The Adyar Estuary During 1982-1983 (μg/gm dry weight).

Sample Detail	Cd	Cu	Ni	Pb	Zn
Whole animal :					
U. (C.) lactea annulipes					
male	0.57 to 1.83	93.00 to 133.04	BDL to 1.94	BDL to 9.50	92.73 to 141.23
female	0.83 to 1.77	93.22 to 119.64	2.66 to 5.53	4.54 to 18.84	115.80 to 131.40
U. (C.) triangularis bengali male	2.02 to 2.91	126.53 to 141.23	3.01 to 3.98	6.59 to 11.37	101.11 to 157.05
female	1.26 to 2.28	96.44 to 133.60	5.23 to 5.55	5.75 to 10.95	80.33 to 161.06

The analysis of whole animals indicates the presence of Cu and Zn in higher concentrations in males and females in both *lactea* and *triangularis*. Similar levels of Cu and Zn may be considered to be due to identical potential of both the species to mobilise them from the environment. The concentration factor rose considerably at each level of the ecosystem many fold. The concentration of Zn in the sediments was 65 times when compared to brackish water and on reaching the body of *annulipes* it shot up by another three times indicating the presence of Zn approximately two hundred times more than the brackish water. Cu concentrations went up to 120 times in the sediments and in *annulipes* it was concentrated three fold indicating 360 times mobilization from the brackish water. Cd level rose 7 times in sediments and another

8 fold increase could be noticed in *lactea* when compared to the sediments. Twenty-seven fold increase occurred in Ni concentrations in sediments and no increase occurred in the body of the animal indicating conformity with the environment. In the case of Pb, sediments received 26 times the concentration of it in the water and the animal showed conformity with the environment. The heavy metal concentrations are comparable in *lactea annulipes* and *triangularis bengali* and in the latter concentrations were relatively more.

Assay of the different parts of the body indicated the differential distribution of metals (Table). Ni appears to be picked up by gills, hepatopancreas and ovary. Cu is concentrated in the hepatopancreas appreciably. Ovigerous females showed the accumulation of Zn in the ovary. High concentrations of Cu and Zn in the gills may be partly attributed to adsorption. Pb gets accumulated in the hepatopancreas and ovary. It is interesting to note that the gills do not retain Pb. Both males and females appear to concentrate Pb to similar levels. The concentration of Pb in the algae of this region being 23.64 μg on average, gets magnified twice and incorporated into the hepatopancreas. Female *lactea annulipes* accumulates more Ni and Pb and *triangularis bengali* Ni only when compared to males. Carapace and appendages carry lower load of metals and a significant quantum of it may account for adsorption as well.

Table III. Heavy metal concentration ranges in *U.* (*C.*) *lactea annulipes* of the Adyar estuary and backwater during 1982-1983. (μg/gm dry weight)

Nature of sample	Cd	Cu	Ni	Pb	Zn
Carapace and appendages	0.59 to 2.35	43.24 to 77.98	0.88 to 9.90	BDL to 18.84	40.04 to 78.39
Gills	0.99 to 28.13	56.77 to 466.94	BDL to 21.24	BDL to BDL	24.90 to 390.50
Hepatopancreas	BDL to 4.99	66.73 to 345.92	BDL to 17.24	BDL to 41.01	32.55 to 394·15
Ovary	BDL to 6.52	21.21 to 97.75	BDL to 17.56	BDL to 32.90	42.90 to 465.13

Daniel and Ramakrishna (1985 Unpublished) noted that all these heavy metals were in higher concentrations in *Uca* when compared to another shore living crustacean *Ocypoda quadrata*. Translocation of metals from gills to hepatopancreas when optimal salinity and temperature occurred in the environment is a known phenomenon (Vernberg and Vernberg, 1975 ; Vernberg et al, 1974). Cu and Zn are regulated to some extent by crustaceans. Since Cu has a direct physiological bearing on the crustacean blood, it is preferentially accumulated. Further, Cu concentration may vary from individual to individual due to the moult-intermoult cycles and hence the vast difference between the minima and maxima.

SUMMARY

Studies on heavy metal concentrations show the magnification of discharged metals as they pass on from one trophic level to another. Amongst the fiddlers, *triangularis* appears to pick up a higher load of metals than its relative. No significant difference has been observed between males and females. Nickel appears to be taken up by the gills, hepato pancreas and ovary. Copper gets accumulated in the hepato pancreas. Ovigerous females exhibit higher concentrations of zinc in the ovary.

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