

Studies on Copper Dynamics in Zooplankton from Bay of Bengal and Andaman Sea

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Abstract- The current study focused to evaluate one of the important trace metal concentrations in mixed zooplankton from the waters of Bay of Bengal and Andaman Sea. The average concentration of copper from northern Bay of Bengal, central Bay of Bengal, southern Bay of Bengal, and eastern Bay of Bengal on dry weight basis was reported as $65.36 \mu\text{g.g}^{-1}$, $58.54 \mu\text{g.g}^{-1}$, $48.86 \mu\text{g.g}^{-1}$, $43.50 \mu\text{g.g}^{-1}$ respectively and average surface sea water copper concentration from the northern Bay of Bengal, central Bay of Bengal, southern Bay of Bengal, and eastern Bay of Bengal was reported as 1.33 ppb, 1.30 ppb, 1.02 ppb, and 0.84 ppb respectively. The copper concentration in the mixed zooplankton from the waters of the Andaman Sea ranged from 36.25 to 58.32 $\mu\text{g.g}^{-1}$ with an average of $43.14 \mu\text{g.g}^{-1}$ and its surface seawater concentrations ranged from 0.78 to 1.29 ppb with an average of 0.93 ppb.

Index Terms- Atomic absorption spectrophotometer, Zooplankton, Copper, and trace metal.

I. INTRODUCTION

Zooplankton accumulate metals by direct absorption from water and also by assimilation through food substances (Couture and Kuman, 2003; Chen *et al.*, 2000). Along the East Coast of India, several large rivers (Brahmaputra, Ganges, Mahanadi, Godavari, Krishna and Kaveri) drain into the coastal waters and contribute to the terrestrially derived trace metal loads. These rivers deliver large quantities of sediment that are constantly moved north or south, depending on the direction and angle of wave approach with respect to the coast (Alagarsamy and Zhang, 2005; Kumar, *et al.*, 2006). Spatial studies of metal concentrations in surface zooplankton from the Indian Exclusive Economic Zone (EEZ) of the Arabian Sea and Bay of Bengal have revealed particularly high metal concentrations at river mouths, upwelling zones, and eddy mixing zones, in comparison to other areas (Rejomon, 2005; Rejomon *et al.*, 2008). The excellent investigations dealing with trace metal levels in plankton were documented all over the world Oceans (Gajbhiye *et al.*, 1985; Govendaswamy *et al.*, 1999 and Rejomon *et al.*, 2008).

So far, a single report is available on the distribution of trace metal concentration in the zooplankton from the waters of the Bay of Bengal (George and Kureishy (1979) and the Andaman Sea (Kureishy *et al.*, 1983), though these waters are receiving

huge quantities of freshwater with metal load of terrestrial and anthropogenic inputs along the east coast of India, Bangladesh and Myanmar. Therefore, the author has undertaken to investigate on the distribution and comparison of Copper in the mixed zooplankton and in the ambient seawater from the waters of the Bay of Bengal and the Andaman Sea.

II. MATERIALS AND METHODS

The study area includes the Bay of Bengal (4° to 23° N latitude and 80° to 93° E longitude) from northeastern part of the Indian Ocean. The Andaman Sea (6° to 14° N latitudes and 91° to 94° E longitudes) is small and partially isolated portion of Northeastern Indian Ocean.

Metal analysis

Atomic absorption with or without flame is a versatile technique for the determination of trace elements in natural waters, plants and biological materials and particulate samples.

Metals in Zooplankton

Dried and powdered zooplankton samples were used to estimate metal concentration in copper. Powdered samples were digested in Teflon bombs with concentrated HNO_3 , the volume of the sample solution made up to 25 ml with 4N HNO_3 solution. The concentration of the metals was determined by Flame Atomic absorption spectrophotometer (microprocessor controlled Varian Atomic absorption spectrophotometer). The metal concentrations were determined by using the formula

Metal concentration in the sample (ppm) = Metal concentration in solution \times V/Weight of the sample. Where V is the volume of the sample solution.

Jan and Young, 1978 method is used for the analysis of metals in sea water.

III. RESULTS

Concentrations of copper in the mixed zooplankton and in the ambient seawater from the waters of the Bay of Bengal and the Andaman Sea and a detailed station wise variation of copper in the mixed zooplankton and in the surface seawater from these waters is shown in (Table 1).

Table 1: Concentration of copper in the mixed zooplankton ($\mu\text{g.g}^{-1}$ dry weight) and in the surface seawater (ppb) from the waters of the Bay of Bengal and the Andaman Sea Bay of Bengal (premonsoon season)

St. No.	Northern Bay of Bengal		St. No.	Central Bay of Bengal		St. No.	Southern Bay of Bengal	
	Zooplan- kton	Surface seawater		Zooplan- kton	Surface seawater		Zooplan – kton	Surface seawater
1	78.52	1.48	5	60.51	1.33	9	56.23	1.13
2	61.62	1.31	6	61.35	1.38	10	50.40	1.11
3	60.92	1.28	7	59.10	1.25	11	48.51	0.98
4	60.40	1.23	8	53.20	1.23	12	40.32	0.86

Andaman Sea (northeast monsoon season)

St. No.	Eastern Bay of Bengal		St. No.	Andaman Sea	
	Zooplankton	Surface seawater		Zooplankton	Surface seawater
1	38.35	0.64	7	36.25	0.88
2	40.32	0.75	8	38.36	0.83
3	41.36	0.88	9	40.26	0.84
4	44.72	0.89	10	40.95	0.78
5	46.16	0.91	11	58.32	1.29
6	50.11	0.98	12	44.71	0.95

The concentration of copper in the mixed zooplankton from the waters of the northern Bay of Bengal varied from 60.40 to 78.52 $\mu\text{g.g}^{-1}$ with an average of 65.36 $\mu\text{g.g}^{-1}$ dry weight and its concentration in the surface seawater ranged from 1.23 to 1.48 ppb with an average of 1.33 ppb. The concentration of copper in the mixed zooplankton from the waters of the central Bay of Bengal ranged from 53.20 to 61.35 $\mu\text{g.g}^{-1}$ with an average of 58.54 $\mu\text{g.g}^{-1}$, its surface seawater concentration, ranged from 1.23 to 1.38 ppb with an average of 1.30 ppb, and the concentration of copper in the mixed zooplankton from the waters of the southern Bay of Bengal ranged from 40.32 to 56.23 $\mu\text{g.g}^{-1}$ with an average of 48.86 $\mu\text{g.g}^{-1}$ and its surface seawater concentration ranged from 0.86 to 1.13 ppb with an average of 1.02 ppb.

Copper concentrations in the mixed zooplankton from the waters of eastern Bay of Bengal varied from 38.35 to 50.11 $\mu\text{g.g}^{-1}$ with an average of 43.50 $\mu\text{g.g}^{-1}$ and its surface seawater concentration ranged from 0.64 to 0.98 ppb with an average of 0.84 ppb. The copper concentration in the mixed zooplankton from the waters of the Andaman Sea ranged from 36.25 to 58.32 $\mu\text{g.g}^{-1}$ with an average of 43.14 $\mu\text{g.g}^{-1}$ and its surface seawater concentrations ranged from 0.78 to 1.29 ppb with an average of 0.93 ppb.

IV. DISCUSSION

The copper concentrations in the mixed zooplankton observed in the present study is similar to those reported in the zooplankton from the sea waters elsewhere. Nicholls *et al.*,

(1959) reported copper concentration in the marine plankton in the range 13 (coelenterates) to 2700 ppm (molluscs). The copper concentration in the bivalves from the Tasman Bay, New Zealand varied from 1 to 131 ppm dry weight (Brooks and Rumsby, 1965). Martin (1970) reported copper concentration in the zooplankton from the surface waters of southwest Puerto Rico, in the range 30 to 270 $\mu\text{g.g}^{-1}$ dry weight. George and Kureishy (1979) reported the copper concentration in the mixed zooplankton from the coastal and inshore waters of the Bay of Bengal, varied from 3 to 228 ppm dry weight. Romeo and Laumond (1980) reported copper concentration in the surface zooplankton from the Bays of Villefranche, Nice, and Cannes of N.W. Mediterranean, in the range 5.9 to 129.1 $\mu\text{g.g}^{-1}$ dry weights. The copper concentration in the zooplankton from the near shore waters of Bombay, west coast of India, varied from 16.25 to 305 ppm dry weight (Gajbhiye *et al.*, 1985). Romeo and Nicolas (1986) reported copper concentration varying from 12.6 to 28.9 $\mu\text{g.g}^{-1}$ dry weight in the planktonic crustaceans from the east coast of Corsica.

The concentration of copper in the zooplanktonic copepods ranged from the 14 to 160 $\mu\text{g.g}^{-1}$ from the Fram Strait and the Greenland Sea (Ritterhoff and Zauke, 1997). Govindasamy *et al.*, (1999) reported copper concentrations in the zooplankton from the coastal waters of Coromandel Coast, east coast of India ranged from 25.80 to 306.50 $\mu\text{g.g}^{-1}$. Kahle and Zauke (2003) reported the copper concentration in Antarctic copepods, ranged from 6 to 52 $\mu\text{g.g}^{-1}$ from Weddell Sea (Antarctica). Fang *et al.*, (2006) reported the copper concentration in the copepods from the ocean outfall area off the northern Taiwan coast, ranged from 14 to 160 $\mu\text{g.g}^{-1}$. Rejoman *et al.*, (2008) reported the copper concentrations in the zooplankton from the coastal and offshore waters of the eastern Arabian Sea and the western Bay of Bengal, ranged from 3.40 to 65.50 $\mu\text{g.g}^{-1}$ for the coastal water zooplankton and from 3.40 to 30.9 $\mu\text{g.g}^{-1}$ for the offshore water zooplankton of the Arabian Sea, while in the zooplankton of the Bay of Bengal, the respective copper concentrations are from 8.20 to 42.30 $\mu\text{g.g}^{-1}$ and from 9.2 to 34.2 $\mu\text{g.g}^{-1}$.

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