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Bio-accumulation of some trace metals in the short-neck clam *Paphia malabarica* from Mandovi estuary, Goa

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Abstract

Monthly collections of the clam *Paphia malabarica* were made for period of 1 year from May 2002 to April 2003 from Verem, Mandovi estuary, Goa. Clams were categorised into two groups, 25–35 mm (small size) and 35–40 mm (big size). Significant difference was not observed in the accumulation of metals in the whole soft tissue between the two size groups. Irrespective of size, annual mean, metal content recorded as μg/g dry weight in the whole soft tissue was 3.8, 30.3, 13.5, 36.6 and 105.7, respectively, for Cd, Pb, Cu, Zn and Fe. Of the two toxic elements Cd and Pb, Cd content was almost uniform throughout the year except for a rise in September for the small size and October for the big size. Pb, on the other hand, was low from the beginning of the monsoon and exhibited distinct accumulation from December onwards up to April, May and, to some extent, June. The pattern was similar in both the size groups, the values being higher for the bigger size group. The three essential elements Cu, Fe and Zn exhibit trends similar to one another with peaks in September and December–January in both the size groups. Cadmium accumulation was highest in the mantle and adductor muscle, Lead, in foot, Copper, in digestive gland and gonad, and Zn and Fe, in gills. Correlation coefficient between different metal couplings as tested statistically revealed significant coupling for Zn–Fe (r 0.92) in the bigger size group, the same was observed between Cu–Fe (r 0.62) and Cd–Zn (r 0.94). Seasonal difference in Pb accumulation was highly significant

Keywords: *Paphia malabarica*; Bio-accumulation; Trace metals

1. Introduction

An understanding of the dynamic processes of metal bioaccumulation is of great importance in protecting these organisms and the consumers from the adverse effect of metal exposure. Bivalves are widely used as sentinel organisms for marine pollution detection due to their ability to accumulate metals several orders higher than what is present in the surrounding environment (Phillips, 1976). The factors, which influence metal concentration and accumulation, are bioavailability of metals, season, size, sex, hydrodynamics of the environment, changes in tissue composition and reproductive cycle (Boyden and Phillips, 1981). The short-neck clam *Paphia malabarica* fullfills some of the characters required for a sentinel organism such as availability throughout the year, sufficient tissue for analysis and tolerability to wide range of contaminants. This species is widely distributed along the coast of Goa and forms an inexpensive and delicious seafood among the locals especially during the monsoon when there is scarcity of fish. Wilfred and Abdul (1994) reported the usefulness of this species as a bioindicator for copper pollution. Modassir and Ansari (2000) reported the effect of petroleum hydrocarbons on the physiology and biochemical aspects of this species. In comparison to fish and crustacea, bivalves have a very low level of activity of enzyme systems capable of metabolising persistent organic pollutants such as polyaromatic hydrocarbons and polychlorinated biphenyls. Therefore, information on metal concentration in the tissues of bivalves is of great importance since it reflects the magnitude of environmental contamination more accurately (Phillips, 1980). The present study has been taken up with a view to give information on size- and season-wise difference in trace metal content in the whole tissue, to evaluate the tissue preference of different metals and to assess the extent of heavy-metal contamination in this commercially important species.

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2. Materials and methods

Monthly collections of *P. malabarica* have been made from Verem, Mandovi estuary (Fig. 1) for a period of 1 year from May 2002 to April 2003. Immediately after collection, the specimens were brought to the laboratory and kept in seawater overnight for defaecation. Twenty-five to forty-five specimens of two size groups (35–40 mm and 25–35 mm length) were taken every month for the study. In the laboratory, after taking the biometric measurements, the soft body parts were separated into foot, gills, digestive gland and gonad, mantle and adductor muscle and dried at 70±2 °C. The soft parts of 10 specimens were taken separately to evaluate the metal content of the whole tissue. Samples and blanks for analysis were prepared by digesting known quantity of dry material with concentrated nitric and perchloric acid. After complete digestion, the samples were diluted to 10 ml with acidified double-distilled water and later analysed by flame atomic absorption spectrophotometry (AAS). Mean ratio (wet to dry weight) was used for converting metal content to ppm wet weight. Samples prepared for metal analyses included procedural blanks, standard solutions and certified reference material (TORT-1, National Research Council of Canada, Marine Analytical Chemist Standards Programme). The results for the reference material showed a marginal difference of 2–7.5% with certified values (Cd: 26.3±2.1, Pb: 10.4±2.0, Cu: 439±22, Zn: 177±10, Fe: 186±11).

The dissolved metal content in seawater was determined following the method of Brewer et al. (1969). Briefly, the metals were preconcentrated from seawater using ammonium pyrolidine dithiocarbamate (APDC) as chelating agent and after extraction taken in methyl isobutyl ketone (MIBK) as solvent. The organic extract was further treated with ultra-pure concentrated nitric acid and metals converted to inorganic form and aspirated in AAS.

Concentration factor was determined as a ratio of mean metal content (dissolved) in water (μg/l) and that in the soft tissue (μg/kg wet weight). All the analyses were carried out in duplicate, and the average values are reported in this paper.

3. Results and discussion

Fig. 2 gives the monthwise variation in metal concentrations in the whole soft tissue of two size groups of *P. malabarica*. No significant difference was observed in the accumulation of metals in the whole soft tissue between the two size groups. Table 1 gives the overall range and annual mean concentration of metals (μg/g dry wt) in the whole soft tissue. The values agree with those reported values

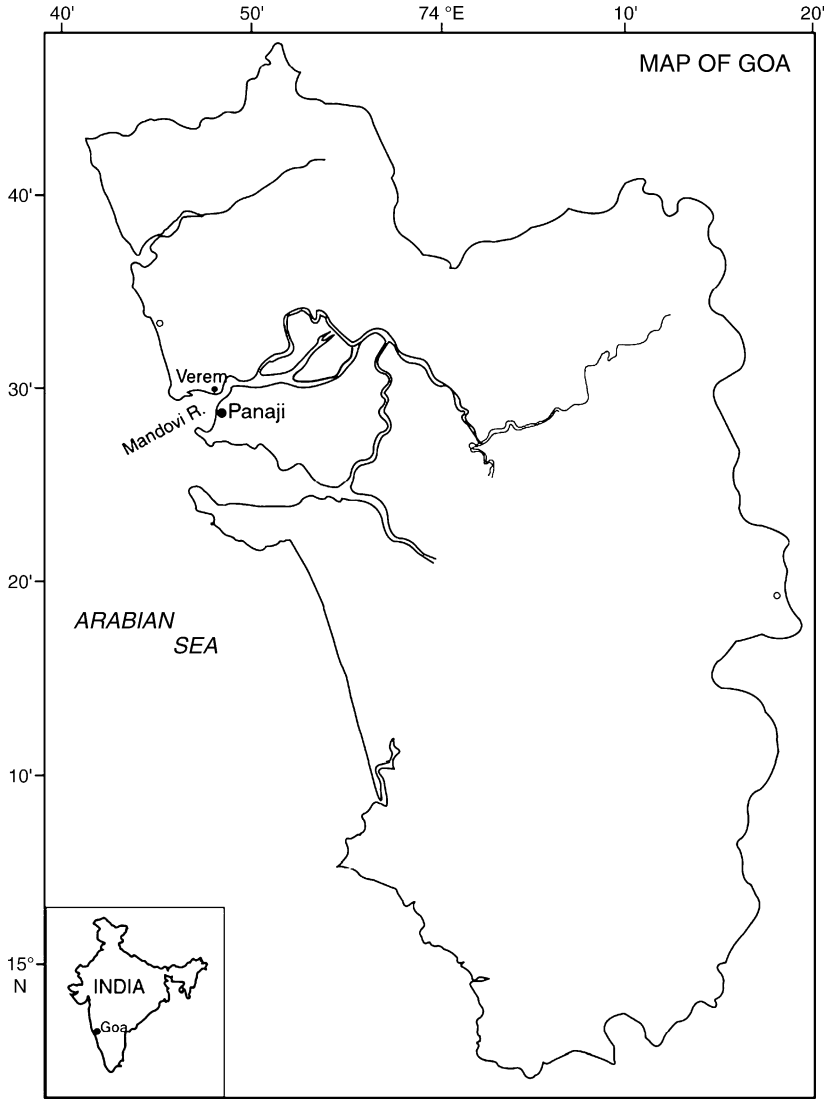

Fig. 1. Station location.