

Bioaccumulation of iron in the freshwater crab (*Potamonautes warreni*) from three industrial, mine and sewage polluted freshwater ecosystems in the Transvaal

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Abstract

An investigation was made into the bioaccumulation of iron in the organs and tissues of the freshwater crab *Potamonautes warreni* (Caiman) from 3 metal-polluted aquatic ecosystems. Differences in water and sediment iron concentrations were related to environmentally induced factors. The highest iron concentrations in the crab occurred in the gills, suggesting this organ to be the prime site for the absorption and/or loss of iron to/from the aquatic environment. Although no seasonal or gender-related tendency in iron concentrations in the various organs and tissues was detected, there appears to be an inverse relationship in the capacity of the crab to bioaccumulate iron with size. A brief discussion is given on the physical and chemical conditions which prevailed at the 3 sampling sites.

Introduction

Iron is a metal which is abundant in nature, constituting 5% of the earth's crust (Friberg et al., 1986). The concentration of this metal can, however, drastically increase in surface waters due to various anthropogenic activities (Moore and Ramamoorthy, 1984). Although iron is vital for most living organisms, it is potentially harmful in all dosages and forms (Friberg et al., 1986). The importance of iron lies in its remarkable capacity to engage in electron transport reactions in biological systems (Neilands, 1974). Ferric hydroxide flocs have been observed to coat the gills of white perch, *Morone americanus*, minnows and silversides, *Menidia* sp. The smothering effects of settled iron precipitates may be particularly detrimental to fish eggs and bottom-dwelling fish food organisms (Train, 1979). Increased exposure of the banded tilapia (*Tilapia sparrmanii*) to iron has been shown to cause an increase in the total white blood cell counts suggesting a stimulation of the immune system to protect the organism against infections which may occur due to iron-mediated damage of the gill tissue (Wepener et al., 1992). However, information on the bioaccumulation of iron in the tissues and organs of decapods is limited in spite of the essential function of this metal in biological systems.

The present study was aimed at determining the iron concentrations in the water, sediments and in selected tissues and organs of the freshwater crab *P. warreni* from three different aquatic environments in the Transvaal, which have been subjected to various degrees of metal contamination emanating from different sources of mine, industrial and sewage pollution. Attempts were made to evaluate seasonality, gender and size of the crab in relation to the bioaccumulation of iron in selected organs and tissues of this organism. *P. warreni* was also considered as a possible indicator organism for iron contamination of freshwater ecosystems.

Study area

The catchment of the Elsburgspruit-Natalspruit River system covers about 225 km². The headwater regions of these rivers are characterised by mine dumps, mine tailing dams, industries and sewage purification works. Because of these intensive mining, domestic and industrial activities this system is severely polluted in some places. Where the Elsburgspruit tributary joins the Natalspruit River (28°10'S:26°19'E), a large expanded wetland ecosystem of almost 8 km is formed (Fig. 1). Six localities with varying metal input were chosen in this wetland ecosystem for the sampling of *P. warreni*.

Crabs were also sampled from the Bronkhorstspruit River (28°41'S:26°00'E) near Delmas, Transvaal, as well as from the Nootgedacht Dam (28°01'S:25°31'E) in Bophuthatswana (Fig. 1). The Bronkhorstspruit River flows mainly through agricultural areas, but is also subjected to urban, industrial and mining effluents, but to a much smaller extent than the Natalspruit River. The Nootgedacht Dam is a shallow 10 ha man-made lake with a mean depth of 2,5 m (Fig. 1). The lake is subjected to limited domestic, agricultural and industrial effluents.

Materials and methods

Water and sediment samples for heavy metal and physico-chemical analyses were collected every second month (usually between 9:00 and 12:00) from the 3 sampling sites mentioned. Water samples were collected in well-rinsed 11 acid-washed polyethylene bottles approximately 10 cm below the surface. Sediment samples were taken from the river bottom (top 5 cm) and at the Nootgedacht Dam, near the edge of the dam in the shallow water. In the laboratory the water and sediment samples were kept at approximately -4°C until analysed.

During each survey the temperature (°C), conductivity (µS/cm), pH and dissolved oxygen (mg/l) were determined directly at the sampling site. The first 3 variables were measured with the aid of Hannah-instruments, while the oxygen was determined with an OXI-96 WTW oxygen meter. Physico-chemical analyses were done with the aid of a Hach model DR-EL/4 engineering kit,

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