A preliminary investigation of the concentration of selected metals in the tissues and organs of the tigerfish *(Hydrocynus vittatus)* from the Olifants River, Kruger National Park, South Africa

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Abstract

^The axial muscle, gill, stomach, intestine, liver, gonads and body fat from tigerfish, *Hydrocynus vittatus* collected during October 1990 from the Olifants River, Kruger National Park, were analysed for Fe, Zn, Pb, Ni, Cu, Cd and Mn by atomic absorption spectrophotometry. The metals were detected in all the tissues examined, but in variable concentrations indicating differences in the accumulation of the metals by the fish. Stomach tissue had the highest mean concentration of Cd (4,5 ± 0,8 |xg-g' wet mass), Mn (7,0 ± 17,7 ug-g-' wet mass), Ni (10,0 + 1,4 ug-g' wet mass) and Pb (14,7 + 3,6 ug-' wet mass). The highest mean concentration of Zn (43,7 ± 74,2 ug-g-^{1} wet mass) was recorded in the gonads. Liver tissue, however, had the highest mean concentrations of Cu (16,6 + 12,1 u.g-g-' wet mass) and Fe (I 634,1 ± 589,6 |Ag-g'wet mass). The derived bioconcentration factors were generally low (lower than 100) suggesting low bioavailability of these metals.

Introduction

The increase in the demand for water by the various user sectors in South Africa has focused attention on the water required for the management of the environment. This has led to the realisation that the environment should also be recognised as one of the user sectors to which water ought to be allocated. The water requirements (quantity and quality) for the management of the environment will, however, depend on the specific ecosystem and situation under consideration.

When evaluating the demand for water of the Kruger National Park, it is evident that this unique nature reserve requires freshwater for potable use, game watering, ecosystem maintenance and to supply downstream users in Mozambique (Department of Water Affairs, 1986; Moore, 1990). During the past two decades the quantity and quality of the water in the rivers of the Park have increasingly been affected by developments to the west of the Park. The catchment areas of the main rivers, namely the Shingwedzi, Luvuvhu, Letaba, Olifants, Sabie and Crocodile Rivers that flow through the Park, for the greater part lie outside the Park and are subject to an increase in urbanisation, irrigation, mining, industries and poor land-use practices (Gertenbach, 1989; 1991).

This study investigates the concentrations of metals (Fe, Zn, Pb, Ni, Cu, Cd and Mn) in tissue samples of the tigerfish *(Hydrocynus vittatus)* from the Olifants River. The total catchment area of the Olifants River is the second largest (54 805 km^2) of all the rivers that flow through the Park, but has areas which have been exploited extensively by the above-mentioned activities. This study was therefore undertaken to evaluate the extent of contamination of tigerfish by metals which may have been introduced into the river system due to mining, industrial and related activities in the catchment area.

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Materials and methods

Tigerfish were collected with rod and reel during October 1990 from the Olifants River, opposite the Olifants Wilderness Trail Base Camp (Site A, Fig. 1). After capture the live fish were placed immediately into polyethylene buckets containing river water and carried to the field laboratory. Fish length, (fork length), weight and sex were recorded for all specimens captured. In order to prevent contamination the dissections were carried out using stainless steel tools on a polyethylene work surface (Heit and Klusek, 1982). The following tissue samples were removed from each fish for analysis: axial muscle, gill, stomach, intestine, liver, gonads and body fat. After dissection, tissue samples were placed in washed polyethylene Nunc cryotubes and stored in liquid nitrogen for later analysis.

At 9:00 on October 12, the surface water temperature (±10 cm below surface) (WTW microprocessor, Model OXT 96), conductivity (Jenway, Model 4070), dissolved oxygen (WTW microprocessor, Model OXT 96) and pH (ORION, Model SA 250) were measured at Site A. Surface water samples for metal analysis were collected during April, June, August and October 1990 at Site B for metal analysis. The bottles were rinsed several times with river water before being filled with this surface water (2 l) which was then frozen.

In the laboratory the tissue and water samples were thawed for further analysis. One gram of tissue was weighed into a 100 *mg* Erlenmeyer flask to which 10 *ml* concentrated nitric acid and 5 *m€* concentrated perchloric acid were added. The acid digestion was performed on a hot plate (200 to 250°C) for at least 4 h during which total digestion and clearing of the samples were achieved. Each of the digested samples was then filtered using a millipore 6 ,u,m paper filter and a vacuum pump. After filtration the filter system was rinsed with double distilled water to remove all traces of the dissolved metal from the filter paper and the filter system. Each sample was then made up to 100 *ml* with double distilled water and stored in clean storage bottles for analysis of the different heavy metals. Due to small sample weight, it was necessary to pool some of the stomach, intestine,