A note on the occurrence of metals in the Olifants River, Eastern Transvaal, South Africa

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Abstract

In order to assess the trace metal status of sediment, water and fish in the middle and lower Olifants River a preliminary investigation into the occurrence of 20 metals was carried out in December 1990. Data collected for the past 8 years on the trace metal content of the Loskop Dam and the Elands River are presented. In general it can be concluded that low levels, representing natural geological background levels, occur in the study area. Elevated levels of some metals do exist at localised points in the study area and warrant further investigation. Arsenic, cadmium, mercury and lead were not detected in any of the aquatic compartments investigated.

Introduction

The Olifants River in the E. Transvaal, South Africa has often been described, without qualification of the sections of the river, nor the pollutants involved, as one of the most polluted rivers in Southern Africa (Batchelor, 1992 and Engelbrecht, 1992). The Loskop Dam has been described as a sink for heavy metals deriving from the upper catchment (Engelbrecht 1992). The fish eagles resident on the Loskop Dam have been found to have the highest pesticide levels accumulated in their eggs (Batchelor, 1992) when compared with data from around South Africa. The results of a pesticide study which coincided with this study are published elsewhere (Grobler, 1993). The question of whether the lower survival rates of crocodile clutches in the Loskop Dam area were pure coincidence or could be linked to the water quality has also been posed (Batchelor, 1992). By implication the whole of the Olifants River has been described as degraded and contaminated with metals and other chemicals.

These concerns have been expressed as a consequence of the large number of agricultural, industrial and mining activities in the catchment. Mining activities consist mainly of coal mining in the upper reaches of the catchment and intensive agricultural activities in the middle and lower catchment and some mining activities on tributaries of the Olifants River in the lower and middle sections of the river.

The catchment area is approximately 54 500 km^2 and constitutes 4.3% of the total surface area of South Africa and 18.9% of the Transvaal. The rivers mean annual runoff is 1 861 x $10^6 m^3$. The mean annual rainfall in the catchment is 660 mm/a (DWAF, 1991).

A limited amount of data is available for the middle and lower Olifants River in terms of trace metals, and the data obtained, for an extensive list of metals, from this study can form part of baseline data to be used in future assessment of the pollution status of the Olifants River as a whole.

Materials and methods

Sampling points and techniques

Bottom sediment samples were collected from the Olifants River inflow into the Loskop Dam, Phalaborwa Barrage, 2 sampling points between the 2 impoundments (B5H002 and B7H007) and from the Selati River (Fig. 1). Samples were collected with an Eckman grab sampler, and stored deep-frozen until analysis.

Fish were collected overnight with gill nets from 2 major impoundments in the Olifants River. Two localities were selected in the Loskop Dam (Lombards Bay and the Olifants River inflow) and one at the Phalaborwa Barrage (Fig. 1). For the purpose of trace metal analysis, 3 fish species, representing different trophic levels, and occurring throughout the study area, were selected for analysis (Table 1). Fish were gutted and decapitated, and wrapped in aluminium foil and stored deep-frozen until sample preparation. Individual fish were homogenised (with scales) using an electric meat mincer which had been pre-washed in RBS-35 soap solution and rinsed well with hot soap water. Subsamples (20 g) from individuals of a species, collected at a sampling point, were pooled, homogenised and analysed.

Water samples were collected from 11 sampling points throughout the study area (Fig. 1), including all the major tributaries in the study area. Both dissolved and acid-extractable metals were determined.

Dissolved trace metal data obtained from the raw water sources of the South Ndebele Water Treatment Works (WTW) for the period 1984 to 1992 are presented. These include data from the Renosterkop Dam (B3M10RR) on the Elands River, Loskop Dam irrigation canal (B3M10LR) and Weltevreden Weir (B3M10WR), the direct abstraction point for the WTW on the Elands River (Fig- **1).**

Analytical techniques

Sediment samples were oven-dried at 45°C, finely ground with a porcelain pestle and mortar and sieved through an 0.2 mm stainless steel sieve to normalise the particle size distribution. Sediment (0.1 g) was digested with 10 m[Aqua regia and 2 m(hydrofloric acid in a polyfluor DGI'.PTFE digestion vessel in a KIC microwave oven. Boric acid (2 g) was added to the sample after digestion to complex the excess fluoride ions, and the digest then filtered through a No. 42 Whatman filter paper into a 100 *rat* volumetric flask. Sediment samples were analysed in duplicate.

One gram wet homogenised tissue was digested stepwise with a nitric and perchloric acid sequence in a polyfluor DGLPTFE digestion vessel in a KIC microwave oven. The digested mixture was then filtered through a No. 42 Whatman filter paper into a 100 ml volumetric flask and quantitatively diluted with deionised water. Fish tissue samples were similarly analysed in duplicate.

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