Bioaccumulation of metals by the southern mouthbrooder, *Pseudocrenilabrus philander* (Weber, 1897) from a mine-polluted impoundment

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Abstract

The bioaccumulation of Fe, Mn, Zn, Cu, Ni and Pb by the cichlid *Pseudocrenilabrus philander* from a mine-polluted impoundment in the Transvaal was investigated. With the exception of Fe, all the other metals were accumulated in higher concentrations in the tissues of the fish than those in the sediments of the lake, with the highest bioconcentration factor being 8.54 for Zn. Results also showed that there was an inverse relationship between metal concentration and body mass of the fish, with the smaller juvenile fish being better able to concentrate all the metals per equivalent body mass than was the case for the larger, adult fish. This phenomenon is linked to a superior bioregulation mechanism for metals by the larger older fish, as well as the relatively higher metabolic rate of the younger juvenile fish.

Introduction

The mining of gold-bearing ores over decades on the Witwatersrand and the deposition of waste products above ground has resulted in the continuous leaching of minerals from these dumps into streams, lakes and rivers. These effluents contributed significantly towards the acidification, mineralisation and metal contamination of the affected water bodies (Wittmann and Förstner, 1976a; 1976b). Changes in the pH of the water have a direct bearing on the solubility and deposition of such metals in the bottom sediments of standing and flowing water ecosystems (Förstner and Prosi, 1979). Plants (Whitton et al., 1981; Van der Merwe et al., 1990) and benthic macro-invertebrates (Nehring, 1976; Eyrest and Pugh-Thomas, 1978) are thus able to utilise these metals directly or indirectly from the sediments. Such metals are transferred from the plants and macro-invertebrate fauna to freshwater fish via several pathways in the food chains in the affected ecosystems (Heath, 1987). Fish which are present in such waters may obtain these metals by means of diffusion through gill and skin surfaces (Matthiessen and Brafield, 1977; Heath, 1987) or, from their natural food (Mathis and Cummings, 1973; Moore and Rama-moorthy, 1984; Villegas-Navarro and Villarreal-Trevino, 1989).

Conflicting reports exist concerning the mechanism involved, and/or the ability of fish to bioconcentrate the various metals in their organs and tissues. Some researchers have found that a positive correlation exists between fish body mass and metal concentration (Phillips et al., 1980; Mohamed et al., 1990), whilst others (Goodyear and Boyd, 1972; Johnson, 1987) recorded no correlation between these two parameters. In some cases, however (ChernoffandDooley, 1979; Anderson and Spear, 1980;Memmert, 1987), a definite inverse relationship was found to exist between body mass and metal concentration.

In the case of the mine-polluted Spaarwater Pan (Fig. 1), a number of fish species still occur, including the cichlid, *Pseudocrenilabrus philander*, also known as the southern mouthbrooder, which is mainly confined to the shallow littoral

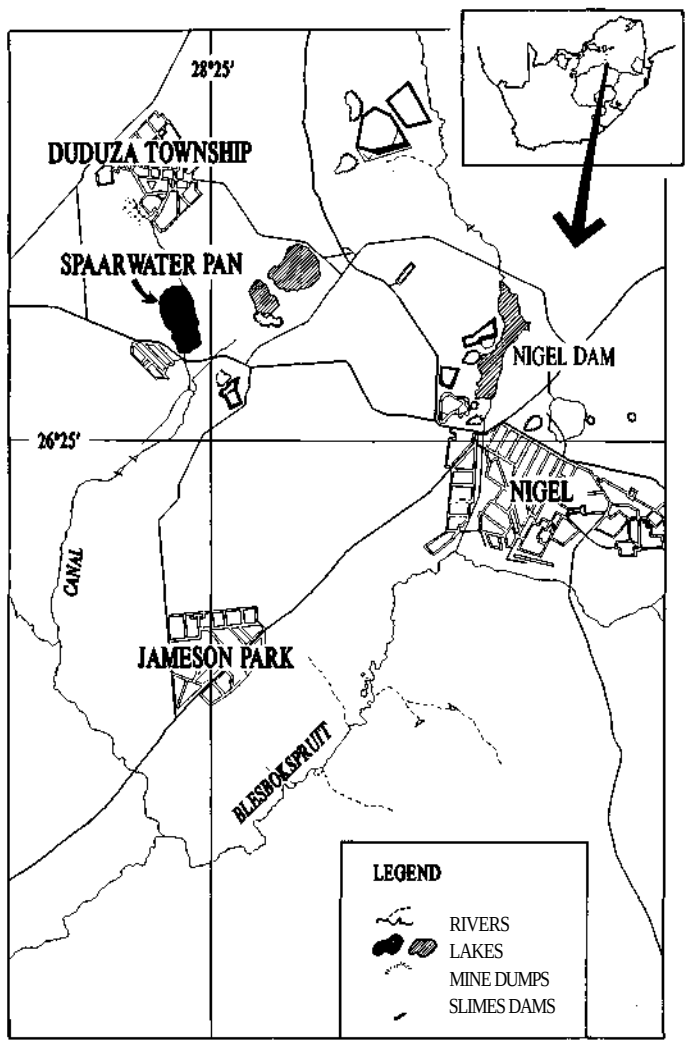

Figure 1
Map showing the location of the Spaarwater Pan near Nigel

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