

Metal concentrations in selected organs and tissues of five Red-knobbed Coot (*Fulica cristata*) populations

Pieter H van Eeden

EcoMonitor cc, PO Box 13434, Norkem Park 1631, South Africa

Abstract

The Red-knobbed Coot *Fulica cristata* is an abundant aquatic bird in South Africa and was anticipated to have indicator abilities for metal pollution. This hypothesis was tested on 83 coot samples collected from five selected aquatic ecosystem areas supporting substantial coot populations, of which various abiotic and biotic components are known to contain varying levels of a number of metals. The aim of this study was achieved by determining the variations in Cd, Cu, Ni and Pb concentrations in liver, kidney, bone and blood samples, with the use of standard flame atomic absorption spectrophotometry techniques. Coots from the Germiston Lake sampling site showed the highest concentrations of cadmium in liver (2.2 µg/g d.w.) and kidney (5.4 µg/g d.w.). The absence of metal-processing industries in the catchments of the Florida Lake and the Steynsrus farm dams reflects the low liver and kidney concentrations of Cd, Ni and Cu, respectively. The blood of the Natalspruit wetland coots contained the highest dry weight concentrations of Ni (11.4 µg/g), Cd (1.8 µg/g) and Cu (14.4 µg/g). The statistical evaluation points towards small-scale geographical differences, especially in the concentrations of Cu, Ni and Pb and in the liver, kidney and blood. However, in terms of actual metal concentrations recorded, no significant differences existed between coots of the reference site (Steynsrus farm dams) and those from the other four localities. It is concluded that the impact of metal-containing diets on the tissue concentrations of these metals in birds plays a far more significant role compared to the migratory habits or short-range movements of the coots.

Keywords: metals, liver, blood, bone, kidney, Red-knobbed Coot, *Fulica cristata*

Introduction

It is documented that a variety of metals are of strategic importance to the industrial world (Greenwood and Earnshaw, 1984). Unfortunately, some metal-processing industries are responsible for various forms of environmental pollution. This results in various impacts on living organisms, including birds, when metal-containing liquid or solid wastes are knowingly or unknowingly discharged into freshwater ecosystems (White and Kaiser, 1976; Kempfand Sittler, 1977; Bull et al., 1983; Ohlendorf et al., 1986). These industrial spillages stimulated the research into the possible use of aquatic organisms to evaluate and monitor the various forms of pollution (e.g. Nybø et al., 1996; Miles and Tome, 1997; Hernández et al., 1999). Certain aquatic or semi-aquatic birds are among the few vertebrate species that have been used as biological monitors of environmental pollution, especially metal pollution. For instance, Munoz et al., 1976 found that the Laughing Gull (*Larus atricilla*) was a useful biological monitor of Pb pollution. In order to be successful indicator organisms, these and other birds need to comply with certain requirements (Phillips, 1977; Ellenberg et al., 1985). They should accumulate metals without being killed by the levels encountered and they should also exhibit a high concentration ratio for metals, allowing direct analysis without the need for any pre-concentration steps. These birds should also have a relatively sedentary home-range behaviour, be abundant in the study region, be sufficiently long-lived to allow sampling of more than one year-class and be of reasonable size in order to allow for the provision of adequate tissues and/or organs for analysis. Their food composition should also be known.

In view of the available information, the Red-knobbed Coot (*Fulica cristata*) can easily qualify as a potential indicator. The Red-knobbed Coot was considered to be the most reliable choice for this study because it was anticipated to have indicator abilities as outlined above and was also abundant.

The water resources of South Africa are under serious threat from metal-containing effluents from industries, mines, sewage purification works, suburban areas and agricultural practices (Department of Water Affairs, 1986) which can seriously influence the aquatic environment and in particular the associated aquatic avifauna. This threat led to this investigation which was subsequently conducted at five selected aquatic ecosystems, which were known to be subjected to various degrees of pollution. The areas surveyed included the Natalspruit wetlands and adjacent Vlakplaats Water Pollution Control Works (WPCW), the Germiston and Florida lakes and the Marievale Bird Sanctuary, all situated within Gauteng Province. A reference site located in the agricultural districts of the Steynsrus-Senekal region in the eastern Free State Province was used for comparative purposes.

Surveys of the available literature suggested that little information exists on the ranges of natural and/or pollution levels of metals accumulated in the organs and tissues of the genus *Fulica* from metal-contaminated aquatic environments. This problem has to some extent been addressed by research into the concentrations of seven metals in 16 organs and tissues of the Red-knobbed Coot from a known metal-polluted aquatic environment in Gauteng Province (Van Eeden and Schoonbee, 1992; 1993).

The aim was to determine whether the Red-knobbed Coot could be an efficient and reliable regional indicator organism of metal contamination by measuring variations in cadmium (Cd), copper (Cu), nickel (Ni) and lead (Pb) concentrations in the liver, kidney, bone and blood of birds collected from five widely separated populations.

+2711 972-5298; fax: +2711 972-5298;

e-mail: pieter.vaneeden@absamail.co.za

Received 24 October 2001; accepted in revised form 19 April 2003.