A note on PCBs and chlorinated hydrocarbon pesticide residues in water, fish and sediment from the Olifants River, Eastern Transvaal, South Africa

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Abstract

Water, sediment and fish samples were collected from the Olifants River and analysed for 10 chlorinated pesticides and 2 polychlorinated biphenyls (Arochlors 1254 and 1260) during December 1990. A total of 31 fish representing 3 species were collected from the Loskop and Phalaborwa Dams. Water and sediment samples were collected from 11 sampling sites on all major tributaries on the Olifants River.

No polychlorinated biphenyls (PCBs) or chlorinated pesticides were detected in the water phase and the concentrations in the sediment were loo low to confirm by mass spectrometry. Residues of DDT were found to be present in all the fish specimens collected. Levels of **DDT** were highest in *Eutropius depressiwstris* and much lower in *Oreochromis mossambicus* and *Clarias gariepimts.*

The concentrations of **DDT** were lower than those reported in the literature and were within international criteria for the protection of aquatic life.

Introduction

Chlorinated hydrocarbon pesticides have been in use in South Africa since their development in the mid-1940s but their use was never as intensive as in Europe or North America, where serious environmental contamination problems have been encountered (Van Dyk et al., 1982). Despite this fact, nature conservation agencies of both the central and provincial administrations became progressively concerned about the potential effects on fish and birds in the late 1960s. Analyses of fauna from fresh water and marine environments were started in 1970 (Van Dyk et al., 1982). Although a number of research programmes have been conducted, the amount of data for Southern Africa is limited.

DDT was introduced to Southern Africa in 1945 for the control of malaria mosquitoes to increase production of crops such as maize and cotton (Van Dyk et al., 1982). The use of DDT as an agricultural stock remedy was severely restricted in 1970 and it was withdrawn as a stock remedy in 1974. In 1976 all sales ended except for malaria control by the State (Van Dyk et al., 1982). According to Davies and Randall (1989) approximately 121 t were still being used annually for malaria control in 1985 and circumstantial evidence suggests that considerable stockpiling for agricultural use took place. The use of dieldrin in South Africa was restricted in 1970, withdrawn as a stock remedy in 1974, restricted for use only as a moth-proofing agent, and for tsetse fly and harvester termite control during state emergency in 1979 and finally completely banned in 1982 (Van Dyk et al., 1982).

The very characteristics (high chemical stability) that made PCBs desirable commercial products cause their persistence in the environment. PCBs are not manufactured in South Africa and their presence can thus only be from industrial usage and the possible dumping of products containing PCBs (De Kock and Randall, 1984). It is therefore not surprising that the amount of data available on PCBs in the South African aquatic environment is very limited. Various international reports indicate that the amounts of PCBs in fish, birds and human tissue may still be on the increase, whereas the amounts of DDT are decreasing (Richardson and Ward, 1982).

It has been demonstrated that organochlorines are systematically concentrated in the upper trophic levels of animals. Continued PCB accumulation with continued exposure or increasing age has also been demonstrated by various authors (Baumann and Whittle, 1988). The decline in eggshellthickness provided the first evidence that the insecticide DDT or other organochlorines were largely responsible for declines of raptor populations in Europe and North America. Eggshell thinning in the South African fish eagle population has been reported by Davies and Randall (1989).

The Department of Water Affairs and Forestry initiated this study to investigate the presence of selected PCBs and chlorinated pesticide residues in 3 aquatic compartments (water, sediment and fish) in the middle and lower reaches of the Olifants River, E. Transvaal. DDT was specifically included because at the time of the study it was still used for malaria control in the lower reaches of the study area. The primary objective of the study was to determine the levels of PCBs and chlorinated pesticide residues in water, fish and sediment. A secondary objective was to determine whether recent contamination had occurred.

Study area

The Olifants River basin drains an area of about 54 500 km^2 between its source and the border between the RSA and Mocambique (Fig. 1). Since 1964/65, the cultivated area has consistently been about 24% of the area used for agriculture. In 1981, about 12% of the cultivated area, or 52 000 ha, was irrigated. At present, about 70 000 ha are irrigated in the study area. The middle portion of the Olifants River catchment which includes the Loskop and Rust de Winter Irrigation Schemes is a major cotton-producing region.

Sampling sites

Fish samples were collected at 2 points on Loskop Dam and one on the Phalaborwa Barrage. Water and sediment samples were collected from the 2 impoundments, from all major tributaries and from selected points on the Olifants River (Fig. 1).

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