



## RESEARCH COMMUNICATION

# Pesticide residues in adipose tissue from hippopotami (*Hippopotamus amphibius* L) living in and adjacent to the Luangwa River in Zambia

A. FLÅØYEN<sup>1</sup>, A. POLDER<sup>2</sup>, M. MWASE<sup>3</sup>, B. ALMLI<sup>1</sup> & M.M. MUSONDA<sup>3</sup>

### ABSTRACT

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The concentration of organochlorines (OCs) such as organochlorine pesticides and polychlorinated biphenyls were measured in adipose tissue collected from 14 male hippopotami at Mfuwe in the southern part of the Luangwa National Park, Zambia. The samples contained low levels of OCs, and the concentrations of OCs were comparable to or lower than reported for wild herbivores studied in other parts of the world.

**Keywords:** Hippopotami, organochlorines, polychlorinated biphenyls, pesticides

### INTRODUCTION

Since the 1960s there has been an increased awareness in developed countries of the effects of pollutants on the environment. A similar awareness has in recent years been created in developing countries.

Hepatic and renal concentrations of copper and other trace elements in hippopotami living in and adjacent to the Kafue and Luangwa Rivers in Zambia have previously been reported (Mwase, Almlı, Sivertsen, Musonda & Flåøyen 2002). Samples of the Luangwa hippopotami were collected at Mfuwe in southern Luangwa National Park. This location was chosen as the river, and thus the area, was

presumably uncontaminated with heavy metals and regarded as a reference site. The concentrations of copper and other essential elements were similar to those reported in normal domestic and wild ruminants, and there was no indication of increased concentration of trace elements due to pollution from the mining areas in the Copperbelt.

Organochlorines (OCs) such as organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) are other groups of pollutants that might cause harmful effects on the environment. As Mfuwe is far from intensive farming areas and extensive use of pesticides, and from industrial areas, tissue samples collected from the hippopotami were considered suitable for measuring background levels of OCPs and PCBs.

### MATERIALS AND METHODS

Subcutaneous fat was collected from 14 male hippopotami at Mfuwe in southern Luangwa National Park, Zambia. The samples were taken from the

<sup>1</sup> National Veterinary Institute; P.O. Box 8156 Dep., N-0033 Oslo, Norway

<sup>2</sup> Norwegian School of Veterinary Science, P.O. Box 8146 Dep., N-0033 Oslo, Norway

<sup>3</sup> University of Zambia, Samora Machel School of Veterinary Medicine, P.O. Box 32379, Lusaka, Zambia

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same animals that were included in the study by Mwase *et al.* (2002) on heavy metal and trace element concentrations. The age of the animals ranged from 12–40 years and the median age was 22 years. The adipose tissues were collected using clean stainless steel equipment, placed in clean polypropylene containers and stored below 0 °C. During transportation to Norway, the samples were kept frozen on dry ice. Prior to the chemical analyses the samples were homogenized in a blender.

Concentrations of hexachlorobenzene (HCB), the sum of hexachlorocyclohexane (HCH) ( $\alpha$ -,  $\beta$ - and  $\gamma$ -HCH), the sum of chlordanes (CHLs) (oxychlordanes, *cis*-chlordanes and transnonachlor), the sum of DDTs (p,p'-DDT, p,p'-DDE, o,p'-DDD and p,p'-DDD), mirex, and the sum of 34 PCBs (IUPAC nos. 28, 31, 47, 52, 56, 66, 74, 87, 99, 101, 105, 110, 114, 118, 128, 136, 137, 138, 141, 149, 151, 153, 156, 157, 170, 180, 183, 187, 189, 194, 196, 199, 206 and 209) were measured by accredited methods (NS-EN ISO/IEC 17025, Norwegian Accreditation) at the Laboratory for Environmental Toxicology of the Norwegian School of Veterinary Science in Oslo, Norway. The extraction, lipid clean-up and GC-ECD analyses were done according to accepted methods (Brevik 1978, Bernhoft, Wiik & Skaare 1997). PCBs 29, 112 and 207 were used as internal standards. Quantification limits for the individual OCPs and PCBs were 0.02–0.12 ng/g in subcutaneous tissue. The percentages of recoveries were in the range of 98–144%.

## RESULTS

Very low concentrations of OCs were detected in the tissue from the animals studied (Table 1). The dominating OCs were the sum of DDTs, followed by the sum of PCBs, HCB, the sum of CHLs, mirex

and the sum of HCHs. Gamma-HCH was the main contributor to sum HCHs with 96%, while  $\alpha$ -HCH was only detected in two samples, and  $\beta$ -HCH was not present in any of the samples. The concentrations of o,p'-DDD were below the detection limits, whereas p,p'-DDE and p,p'-DDT contributed 48% and 49% to the sum of DDTs, respectively. Of the 35 PCBs tested for only nine were detected in the samples analysed. PCB 138, 153, 156, 170, 180 were detected in all 14 samples, PCB 118 and PCB 149 in 12 of the 14 samples, and PCB 105 and PCB 157 were present in 10 of the 14 samples. PCB 153 was the dominating PCB congener contributing 23% to the sum of PCB. The percentage fat varied considerably between the samples.

## DISCUSSION

Hippopotami are herbivores, which, in general, are known to biomagnify only low levels of OCs in their tissues (Thomas, Tracey, Marshall & Norstrom 1992). The results obtained in this study were in agreement with those of herbivores living in other parts of the world. HCB, sum HCHs, sum CHLs, sum DDTs, sum PCBs have previously been found in concentrations of 1.34, 0.24, 0.31, 1.33 and 7.90  $\mu\text{g}/\text{kg}$  in fat of lambs grazing uncultivated pastures in Greenland (AMAP 2004). Corresponding levels of HCB, sum DDTs and sum PCBs in roe deer from northern Italy have been found to be 1.1, 7.3 and 10.9  $\mu\text{g}/\text{kg}$  fat, respectively (Naso, Zaccaroni, Perrone, Ferrante, Severino, Stracciari & Lucisano 2004). The high ratio of DDT/DDE (median 1.55) found in this study indicates that pp-DDT still is used for insect vector control in the area.

It is concluded that hippopotami in the south Luwanga Valley area are exposed to very low levels of organochlorines, and the concentrations of OCs

TABLE 1 Concentrations of pesticide residues in fat ( $\mu\text{g}/\text{kg}$  wet weight (WW) and  $\mu\text{g}/\text{kg}$  fat weight (FW) from 14 male hippopotami collected at Mfuwe in the southern Luangwa National Park, Zambia during October 1998

Analyte	Median $\mu\text{g}/\text{kg}$ WW	Range $\mu\text{g}/\text{kg}$ WW	Median $\mu\text{g}/\text{kg}$ FW	Range $\mu\text{g}/\text{kg}$ FW
Fat content %	64	5.1–87		
HCB	0.60	0.17–3.2	1.4	0.74–4.8
Sum HCH	0.09	0.04–0.14	0.18	0.05–1.3
Sum Chlordanes	0.41	0.31–5.2	0.68	0.52–7.2
Sum DDT	2.25	1.8–18	4.4	2.7–36
Ratio DDT/DDE	1.7	0.08–5.0	1.7	0.08–5.0
Mirex	0.13	n.d. <sup>a</sup> –0.49	0.24	0.12–0.73
Sum PCB	1.7	0.76–1.5	1.8	1.3–28

<sup>a</sup> n.d. = not detected (one animal)

are comparable to or lower than reported for wild herbivores studied in other parts of the world.

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