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Lead and Mercury Levels in Raccoons from Macon County, Alabama

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Heavy metal contamination in the environment has become a major concern of the scientific community. The ubiquitous presence of heavy metals such as lead, mercury, and cadmium in wildlife animals has been reported (Hoff et al. 1977, Elfving et al. 1978, and Clark et al. 1982). Although the understanding of the full significance of these metals is incomplete, it is known that some species contain concentrations of metals proportional to the levels present in their environments (Everett and Anthony, 1976). Thus, wild animals can be used as biological indicators of environmental concentrations of metals (Martin 1972 and Ohi et al. 1974). The behavior, omnivorous feeding habits, and adaptability of raccoons (*Procyon lotor*) qualify this animal as a useful indicator of environmental pollution (Bigler et al. 1975). The purpose of this paper was to report some preliminary observations on lead and mercury levels in raccoons from Macon County, Alabama, a potential indicator species for wildlife.

MATERIALS AND METHODS

Liver and kidney samples were collected from 15 hunter-killed raccoons in Macon County, Alabama, USA, between 1992 and 1993 hunting season. Upon collection, sex of the raccoon was recorded. The liver and kidney samples were placed individually in plastic bags and frozen at -20°C until analyzed. Liver and kidney samples were digested in 10 ml of a 7:3 mixture of ultrapure concentrated HNO_3:$HClO_4$ in 250-ml flask. The solutions were allowed to stand overnight for complete digestion. The solutions were then heated until evaporated at 95°C. The residues were redissolved in 10 ml of 1N HNO_3. The resulting solutions were filtered through Whitman no. 41 filter paper and analyzed for Pb by Inductively Coupled

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Plasma Atomic Emission Spectroscopy. Dogfish liver (Certified reference materials for trace metals) samples were analyzed for Pb along with liver and kidney samples. Recoveries ranged from 90% to 96%. Total Hg in raccoons liver and kidney samples were also analyzed by the Hatch and Ott (1068) cold vapor atomic absorption method in a Bacharach Coleman Model 50B Mercury analyzer. This procedure uses concentrated H_2SO_4:HNO_3 (4:1) at 58°C for wet-ashing. Dogfish liver (Certified reference materials for trace metals) samples were analyzed for Hg along with liver and kidney samples. Recoveries ranged from 89% to 95%. Mean concentrations of Pb and Hg in livers and kidneys and in the livers and kidneys of males and females were compared with a t-test (Zar 1984). Differences were considered significant if $p \leq 0.05$.

RESULTS AND DISCUSSION

The mean concentrations of Hg and Pb were 0.41 and 3.24 ppm in livers and 0.24 and 4.95 ppm in kidneys, respectively (Table 1). No significant differences in the Hg and Pb contents between livers and kidneys were found. Pb levels in livers and kidneys in this study were above the values reported in the uncontaminated sites. Hoff et al. (1977) found 0.47 $\pm$ 0.22 ppm Pb levels in raccoons from an uncontaminated site in Florida. Herbert and Peterle (1990) recorded Pb levels of 0.24 $\pm$ 0.17 and 0.20 + 0.11 in liver and kidney, respectively in raccoons on National Wildlife refuge in the eastern-central Michigan. However, raccoons from a contaminated site in Connecticut had Pb liver concentrations of 6.2 $\pm$ 5.4 ppm (Ditters and Nielson, 1978) and raccoons within the city limit of Ithaca, NY, had Pb levels of 33.00 $\pm$ 18.68 and 19.77 $\pm$ 7.80 ppm in liver and kidney, respectively (Valentine et al (1988). Sanderson and Thomas (1961) recorded an average liver Pb level of 6.8 $\pm$ 1.8 ppm in Illinois. The Pb residue levels of this study indicate that raccoons in Tuskegee are exposed to environmental Pb. Raccoons in cities feed on garbage, are exposed to greater concentrations of traffic exhaust or frequent storm sewers or other locations where lead may be higher.

Hg concentrations in raccoons from this study were below values given in the literature with respect to liver and kidney (Table 1). Wren (1984), Sheff and Amant (1982), Cumbie (1975), and Herbert and Peterle (1990) reported liver mercury concentrations in raccoons of 4.5 $\pm$ 3.5, 2.01 $\pm$ 0.93, 3.54 $\pm$ 1.5, and 1.18 $\pm$ 0.87 ppm, respectively. Wren (1984) and Sheff and Amant (1982)

Table 1. Mean (S.E.) Levels of Mercury and lead in the livers and kidneys (ppm wet weight) of hunter killed raccoons.

Metals	N	Livers	Kidneys
Hg[a]	15	0.41 ± 0.15	0.24 ± 0.02
Pb[a]	15	3.24 ± 1.07	4.95 ± 1.92

[a] no significant difference between liver and kidney Hg and Pb concentrations.

Table 2. Mean (S.E.) levels of Mercury and lead in the livers (ppm wet weight) of hunter killed male and female raccoons.

Metals	N	Males	N	Females
Hg[a]	8	0.20 ± 0.01	7	0.62 ± 0.29
Pb[a]	8	5.08 ± 1.76	7	1.49 ± 0.36

[a] no significant difference between males and females in Hg and Pb concentrations in livers.

Table 3. Mean (S.E.) levels of Mercury and lead in the kidneys (ppm wet weight) of hunter killed male and female raccoons.

Metals	N	Males	N	Females
Hg[a]	8	0.21 ± 0.02	7	0.24 ± 0.03
Pb[a]	8	4.68 ± 1.7	7	5.22 ± 3.70

[a] no significant difference between males and females in Hg and Pb concentrations in livers.

recorded the kidney mercury levels of 1.1 ± 0.4 and 1.36 ± 0.4 ppm, respectively. Although, these above studies were basically conducted in uncontaminated sites, however, they were located in areas where mercury occurred at naturally high levels in soil and rock. The Hg levels of this study agreed with that of Valentine et al. (1988) who found 0.50 ± 0.45 in raccoons liver.

The levels of Hg and Pb in liver and kidney did not show any significant difference between male and female raccoons. Herbert

and Peterle (1990) recorded no sex-related differences in accumulation of Hg, Pb, Cd, Se, and Zn in raccoons. Snaderson and Thomas (1961) also found no difference in Pb accumulation between sexes. Similarly, Erickson and Lindzey (1988) recorded no significant difference in the levels of lead in livers and and kidneys of male and female muskrats. It appeared that sex was not a major determining factor for heavy metal accumulation in raccoons.

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