Mercury Levels in Georgia Otter, Mink and Freshwater Fish

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It has been suggested that widespread dispersal of mercury to the environment from such sources as fossil fuel combustion, agricultural seed dressings or sewage outfalls could result in low level mercury contamination of food chains over large areas in the absence of recognized point sources of mercury pollution (JOENSUU 1971, LAMBOU 1972). The presence of mercury in fish from a number of river systems in Georgia has been documented by the GEORGIA WATER QUALITY CONTROL BOARD (1971). In most cases mercury levels were low, and only fish from the Savannah River, which received mercury inputs from a chlor-alkali plant, were sufficiently contaminated to be of concern to public health authorities. Terrestrial mammals from the Lower Coastal Plain habitats of southern Georgia exhibit elevated mercury levels in the absence of recognized sources of mercury (CUMBIE and JENKINS 1974). The present paper reports preliminary data on mercury levels occurring in aquatic mammals and fish from a region of the Georgia Lower Coastal Plain which is not associated with recognized point sources of mercury contamination.

Materials and Methods

Hair of otter (Lutra canadensis) and mink (Mustela vison) taken by fur trappers in Georgia in 1973, and axial muscle of fish from the Suwannee River below Okefenokee Swamp, were analyzed for total mercury content by the flameless atomic absorption method (U.S. ENVIRONMENTAL PROTECTION AGENCY (1972). Hair specimens were removed from pelts with dissecting scissors, rinsed in reagent grade acetone and dried in air. Fish axial muscle from the mid-dorsal region was stored frozen until analyzed for mercury content. Specimens were digested in a nitric-sulfuric acid mixture at room temperature and organic compounds were oxidized with potassium permanganate. Following reduction with hydroxylamine hydrochloride and stannous chloride, mercury concentrations were determined with a Coleman MAS-50 Mercury Analyzer (Coleman Instruments, Maywood, Illinois). All analyses were performed in duplicate. Hair and flesh specimens were exchanged with the U.S. Environmental Protection Agency Southeast Environmental Research Laboratory, Athens, Georgia, and the Savannah River Ecology Laboratory, Aiken, South Carolina, where they were analyzed for mercury content by the flameless atomic absorption method as a check on analytical technique. Mercury concentrations are reported in parts per million (ppm), based on dry weights of hair specimens and on wet weights of muscle specimens.

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Results and Discussion

Interlaboratory comparisons of mercury analyses indicated good agreement between my results and those of the two independent analyses. Recovery of mercury as mercuric ion or as methyl-mercuric ion from spiked specimens of hair or skeletal muscle ranged from 85 to 100 percent. The lower limit of detection was 0.02 microgram total mercury per specimen.

Hair has been utilized as an indicator of mercury levels in humans (BIRKE et al. 1972) and in native mammals in the western and southeastern United States (HUCKABEE et al. 1972, CUMBIE and JENKINS 1974). In Georgia, mercury levels of terrestrial mammals from the Lower Coastal Plain tend to be higher than those of mammals from the Piedmont (CUMBIE and JENKINS 1974).

Mercury concentrations detected in otter hair (Table I) ranged from 9.3 ppm to 67.9 ppm. Mean hair mercury concentration of Lower Coastal Plain otter was higher than that of Piedmont otter. An adult male otter whose hair mercury concentration was 35.3 ppm had 1.97 ppm mercury in its skeletal muscle. Mink hair mercury levels ranging from 2.3 ppm to 17.3 ppm were detected, but no difference in mean mercury levels was apparent between Lower Coastal Plain and Piedmont animals (Table I). Small sample sizes preclude further comparison of mercury levels observed in mink and otter from the different physiographic regions at this time.

Mercury levels of fish from the Suwannee River are presented in Table II. These mercury levels were somewhat higher than those detected in fish from other drainages in Georgia which were not considered by the GEORGIA WATER QUALITY CONTROL BOARD (1971) to be significantly affected by point sources of mercury pollution. It should be emphasized that none of the fish for which mercury levels are reported in Table II were larger than 14 inches in length or approximately one pound in weight, since mercury concentrations in fish have been reported to increase with increasing size and age (LAMBOU 1972). This tends to emphasize the significance of these mercury concentrations, which exceed the 0.5 ppm U.S. limit for human foodstuffs, in relatively small chain pickerel (Esox niger), bowfin (Amia calva) and gar (Lepisosteus sp.)

Accumulations of mercury in fish of the streams which drain the Georgia Lower Coastal Plain may be related to nutrient cycling characteristics of Lower Coastal Plain ecosystems (JENKINS and FENDLEY 1968, CUMBIE and JENKINS 1974). Mercury tends to be adsorbed to clays (WARREN et al. 1966, LAMBOU 1972), which are found in high concentration in Piedmont soils. Lower Coastal Plain soils are low in clay content, which would tend to increase the mobility of mercury in the Lower Coastal Plain ecosystems. Acidity of Lower Coastal Plain waters may also influence movement of mercury in food chains, since acid waters are considered to favor accumulation of mercury by fish (NELSON et al. 1971)

TABLE I

Mercury concentrations (ppm) in hair of otter and mink from the Piedmont and Lower Coastal Plain of Georgia

Species	Origin	Sample Size	Mean	Range
Otter (*Lutra canadensis*)	Piedmont	3	15.9	9.3-26.8
	Lower Coastal Plain	6	37.6	15.8-67.9
Mink (*Mustela vison*)	Piedmont	5	10.7	2.3-17.3
	Lower Coastal Plain	2	10.7	5.9-15.4

TABLE II

Mercury concentrations (ppm) detected in axial muscle of fish from the Suwannee River below Okefenokee Swamp, in the Lower Coastal Plain of Georgia

Species	Sample Size	Mean	Range
Largemouth Bass (*Micropterus salmoides*)	2	0.44	0.34-0.53
Chain Pickerel (*Esox niger*)	6	0.81	0.26-1.40
Bowfin (*Amia calva*)	13	0.45	0.28-0.82
Gar (*Lepisosteus* sp)	5	0.42	0.23-0.80
Chubsucker (*Erimyzon oblongus*)	5	0.14	0.12-0.15
Redfin Pickerel (*Esox americanus*)	6	0.39	0.34-0.50

Conclusion

The data reported here indicate that the presence of mercury in fish of relatively unpolluted Lower Coastal Plain streams results in accumulation of mercury by otter and mink which feed on these fish. Otter exhibit hair mercury levels which approach those at which symptoms of neurological disorders have been reported in humans suffering from mercurial poisoning (BIRKE et al. 1972). Subtle effects on behavior resulting from sublethal mercurialism could affect the reproduction and survival of certain populations of otter or mink. Possible sublethal effects of environmental mercury or other pollutants at trace levels on native animal populations deserve further study, since such information would be useful in formulating sound policies regarding discharge of pollutants under varying circumstances. Additional investigation is needed to determine the relative contributions of natural and man-caused mercury inputs to mercury levels observed in native wildlife species.

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