

Ra-226 Concentrations in Otter, *Lutra canadensis*, Trapped Near Uranium Tailings at Elliot Lake, Ontario

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Canada has a significant uranium mining industry which will likely continue to expand in the future. Exploitation of uranium ores has produced large quantities of surface waste tailings near mine sites. The Elliot Lake area of Ontario, is currently the major uranium producing region of Canada. It is estimated there are 120 million tonnes of uranium tailings spread over 600 ha in the vicinity of Elliot Lake (Cloutier et al. 1985). Many inactive tailing sites have been stabilized either chemically or through revegetation.

The transfer and fate of uranium-series radionuclides from tailing sites remain primary ecological concerns in these areas. It has been demonstrated that the levels of radionuclides, including Ra-226, are elevated in vegetation, small mammals and fish living on or near tailing disposal sites (Swanson 1983; Cloutier et al. 1985; Dave et al. 1985). However, the transfer potential of Ra-226 to predatory species has not been examined in detail. The objective of this study was to measure Ra-226 levels in otters (*Lutra canadensis*), captured near tailing sites, to provide further information on the fate of radionuclides in the environment.

MATERIALS AND METHODS

Carcasses of 7 otters were obtained from licensed trappers operating on or within 10 km of uranium mine tailings at Elliot Lake, Ontario (46° 23'N, 82° 39'W), during the 1984-85 trapping season. An otter from the Muskoka area of south-central Ontario, which is remote from uranium mining activity, served as a reference specimen. The skinned carcasses were kept frozen for subsequent analysis. Each carcass was measured for weight, length, and sex determined.

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Hind legs of the carcasses were removed, and as much muscle tissue cut away from the bone as possible. The remaining samples were placed in plastic bags and immersed in boiling distilled water for 2 hours to facilitate removal of the remaining flesh from the bone. Bone samples were then oven dried at 100 C for 16 hours. Moisture content of the bones when dried to a constant weight was $30.8 \pm 1.5 \%$.

Bone samples were slowly ashed in a muffle furnace at a maximum temperature of 550 C for at least 8 hours. Ashes were crushed, digested with nitric acid and oven dried at 70 C overnight. The samples were reashed at 550 C for 12 hours then dissolved in 10% HCl, spiked with a measured amount of Ba-133 tracer, and diluted to 1 l. Analysis of spiked samples indicated a recovery rate of Ba-133 and Ra-226 close to 100%. All analyses were conducted in duplicate on a 250 ml aliquot of the 1 l sample. Ra-226 levels were measured, following precipitation as Ra-Ba sulphate, by alpha-spectroscopy in which the 4.78 MeV alpha-decay peak of Ra-226 was counted, as described by Lim and Dave (1981).

RESULTS and DISCUSSION

Ra-226 levels in otter leg bone ranged from <0.1 to 12.6 pCi/g (Table 1). To our knowledge this is the first study to report Ra-226 levels in a wild piscivorous mammal species in Canada. Ra-226 was detected in 5 of 7 samples from Elliot Lake, but was not detected in the sample from the control area.

Table 1. Concentration of Ra-226 in otter bones from Ontario.

LOCATION	SEX	WEIGHT* (g)	LENGTH (cm)	Ra-226 (pCi/g)
Elliot Lake	M	5595	108.5	12.6
	M	6285	95.5	1.2
	M	2965	75.5	< 0.1
	M	5710	100.5	0.5
	M	4685	97.0	< 0.1
	F	4740	101.0	0.2
	F	3375	91.5	0.8
Muskoka	M	5985	102.0	< 0.1

* carcass weights do not include pelt weight.

Cloutier et al. (1985) reported that the average Ra-226 level in bone of meadow voles (Microtus pennsylvanicus) caught on the Elliot Lake uranium mine tailings was 52.3 pCi/g. In that study, Ra-226 was detected in gut, skin and bone, but not in other tissues analyzed. Coyotes (Canis latrans) living near radioactive wastes in the USA are reported to accumulate radionuclides through the ingestion of small mammals (Arthur and Markham 1982).

Swanson (1983) observed Ra-226 levels up to 70 pCi/g in spottail shiners (Notropis hudsonius) in waters near a uranium mine and mill in Saskatchewan, Canada. Fish Ra-226 levels were higher in bottom-feeding forage species, such as white sucker (Catostomus commersoni), than in piscivorous species such as lake trout (Salvelinus namaycush). It was determined that the main transfer pathway of radionuclides was via the sediments, either through direct contact or by feeding on benthic organisms.

The diet of otters is comprised almost entirely of fish, plus clams, crayfish and some birds and small mammals (Toweill and Tabor 1982). Furthermore, the fish species consumed are primarily slower moving bottom feeders, such as suckers and shiners, shown to accumulate the highest levels of Ra-226. Clams and other benthic invertebrates have also been shown to accumulate significant levels of radionuclides (MOE 1978). Therefore, wildlife species such as otters, mink and raccoon, feeding on benthic aquatic organisms near tailing sites are potentially exposed to relatively high dietary Ra-226 levels.

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