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Mercury in Polar Bears from Alaska

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ABSTRACT: Alaskan polar bear (*Ursus maritimus*) muscle and liver samples collected in 1972 were analyzed for total mercury. Bears north of Alaska had more mercury than bears west of Alaska. The only difference between young and adult animals was in the northern area where adults had more mercury in liver tissue than young animals. Levels were probably not high enough to be a serious threat to bears.

Key words: Mercury, polar bear, contaminant, Arctic, Alaska, *Ursus maritimus*.

This study reports mercury levels in Alaskan polar bears in 1972, before large-scale industrial development in northern Alaska. Findings are relevant now as a base for comparison with present day mercury levels after industrial development for extraction of fossil fuels has occurred.

Alaska Department of Fish and Game personnel obtained liver and muscle samples from polar bears killed by hunters from February to April 1972. Females accompanied by young were legally protected from hunting and were not part of the sample. Samples came from two hunting areas (Fig. 1). The western area in the Chukchi Sea extended from Bering Strait north to 69°N latitude. The northern area at the interface of the Chukchi and Beaufort seas included sea ice within a 250 km radius of Point Barrow. Bears were aged based on tooth cementum layers, tooth wear, and skull size. Sex was determined from mammae and remains of genitalia on skins saved by hunters.

Samples were wrapped in aluminum foil, sealed in plastic bags, and kept frozen until analyzed for total mercury during the following 6 mo at the Institute of Arctic Biology, University of Alaska. Loss of mercury was not detected in four samples of muscle, each of which had portions analyzed early and late in this 6-mo period.

Tissues were analyzed by flameless atomic absorption (Hatch and Ott, 1968) after digestion overnight under reflux conditions in a 3 to 1 nitric acid–sulfuric acid mixture. Permanganate and cadmium were added to the digest and reducing agent following procedures of Armstrong and Uthe (1971) and Magos and Clarkson (1972) to digest methylmercury. Three analytical controls were: (1) duplicate analysis of the same sample which gave values ±4% ($n = 10$) of expected values, (2) standard addition which gave values ±7% ($n = 5$) of expected values, and (3) neutron activation analysis of paired samples in another laboratory (Environmental Trace Substances Research Center, University of Missouri, Columbia, Missouri 65203, USA) which gave values ±8% ($n = 5$) of expected values.

Data for males and females were combined when no differences were found in their mean mercury levels (t-test, $P > 0.05$). Data were grouped into eight categories by area, tissue type, and age (young, 2–5 years; adult, >5 years), and differences in mean mercury levels were compared by a non-parametric Wilcoxon two-sample test.

Mean mercury levels were much higher in liver than in muscle (Table 1, $P < 0.01$ for comparisons of tissue type by area and age group). Levels of mercury in muscle tissue were not different for young and adult animals (Table 1, $P > 0.05$ for comparisons of age groups for western and northern areas). In the northern area, adults

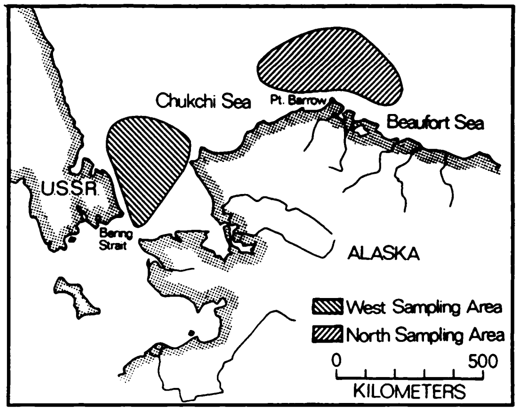

FIGURE 1. Map showing areas where polar bear tissue samples for mercury analysis were obtained.

had a higher mean level of mercury in liver tissue than young animals (Table 1, $P < 0.02$). In the western area, mean levels in liver in young and adult animals did not differ significantly (Table 1, $P > 0.05$). Mean mercury levels were higher in tissues from the northern area than in tissues from the western area (Table 1, $P < 0.05$ for comparisons of areas by tissue type and age group).

The possible effect of mercury on bears is of concern, especially in the northern area were mercury levels are high. In mark-recapture studies, Lentfer et al. (1980) captured more than 600 bears in the northern sampling area from 1967 through 1976. None of these showed obvious signs of mercury intoxication.

Polar bears probably obtain mercury from ringed seals (*Phoca hispida*), their principal food. Smith and Armstrong (1978) reported high levels of mercury in livers of ringed seals (27.5 ppm) and bearded seals (*Erignathus barbatus*, 143 ppm) from Holman, West Victoria Island, in the Canadian Arctic. They reported no evidence of mercury intoxication in these seals and said it appears likely that marine mammals in general have developed mechanisms enabling them to cope with the substantial amount of mercury that occurs naturally in their diets. Eaton et al. (1980), in an experimental assessment of the toxic potential of mercury in ringed seal liver for adult laboratory cats (*Felis domesticus*), found that despite the extremely high total mercury content of seal liver, only the small organic mercurial component is absorbed and appears in the tissues. They found no neurologic or histopathologic effects in cats on a diet of ringed seal liver containing a mean of 26 ppm total mercury for 90 days.

The lack of effects in captured bears, in experimental cats, and in ringed and bearded seals with high mercury levels suggests that levels of mercury as reported here are not a serious threat to bears. There is no clear explanation for the higher levels of mercury in polar bears from the northern sampling area. Unfortunately, data are not available that provide comparisons of mercury in the environment and food webs supporting polar bears in the two areas.

Differences in origin and composition of the water mass in each sampling area might contribute to different mercury levels in the two areas. The western area

TABLE 1. Total mercury (ppm wet weight) in Alaskan polar bear tissue samples by geographical sampling area, 1972.

		Western area			Northern area		
Tissue	Age class[a]	*n*	Mean	SE	*n*	Mean	SE
Muscle	Young	12	0.04	0.004	19	0.15	0.002
	Adult	4	0.04	0.013	11	0.19	0.030
Liver	Young	16	3.92	0.319	22	22.35	4.690
	Adult	9	4.80	0.487	15	38.08	5.194

[a] Young, 2–5 yr; adult, >5 yr.

receives a greater proportion of water from the northern Pacific Ocean by way of Bering Strait (Coachman et al., 1975). Fresh water draining to the two areas is also from different sources. The western sampling area receives water from western Alaska and the eastern coast of the Soviet Union. The northern sampling area receives fresh water from rivers of northeastern Alaska and northwestern Canada.

Differences in availability and utilization of prey species by polar bears in the two areas may result in differences in diets and mercury levels of polar bears. The primary prey species of polar bears are ice-associated ringed seals and bearded seals. Bearded seals are bottom feeders (Lowry et al., 1980a) and prefer shallower water areas than ringed seals (Stirling et al., 1977). During the period when the shallow Chukchi Sea is ice covered, it has a greater proportion of bearded seals to ringed seals than the deep-water Beaufort Sea. Data are not available, but it is assumed that a greater proportion of bearded seals to ringed seals in the Chukchi Sea results in a diet for polar bears with a greater proportion of bearded seals in the western sampling area than in the northern sampling area.

Differences in diets of ringed seals in the two areas might also contribute to differences in mercury levels in polar bears. Ringed seals feed on crustaceans and fishes in both the Chukchi and Beaufort seas, but the proportion of fishes in the diet is greater in the Chukchi Sea (Lowry et al., 1980b).

Walruses (*Odobenus rosmarus*) in the form of carrion and live animals are also available and utilized for food to a limited extent by polar bears in the Chukchi Sea (Fay, 1982). Walruses are bottom feeders and not available to polar bears in most of the Beaufort Sea (Fay, 1982).

Data on mercury in polar bears from other locations are available for comparison. Mean level and range in polar bear muscle tissue from 19 animals from six locations in Canada during the period 1971–1976 were 0.19 (0.01–1.20) ppm, and a polar bear liver sample from Cornwallis Island, Resolute Bay, Canada had 55.2 ppm mercury (Sherbin, 1979). Eaton and Farant (1982) analyzed hair samples from 146 Canadian polar bears for mercury and found substantially higher levels in the western Canadian Arctic than in the eastern Canadian Arctic and Hudson Bay.

In conclusion, it would be desirable to periodically monitor mercury levels in polar bear tissue for an indication of change of level in the arctic marine environment and potential threat to bears. Data reported in this paper would serve as a base for comparison of mercury levels before and after large-scale industrial development, mainly oil and gas extraction, in arctic Alaska.

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Strychnine Poisoning of Aquatic Birds

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ABSTRACT: Strychnine poisoning was diagnosed in free-flying mallards (*Anas platyrhynchos*) and a ring-billed gull (*Larus delawarensis*) found dead on a pond in a zoo. The probable source of toxin was improperly applied strychnine-treated grain used for control of rodents on adjacent farm land. Ingesta of the birds contained 19.7–85.1 mg/kg of strychnine.

Key words: Strychnine, toxicosis, mallard, ring-billed gull, *Anas platyrhynchos*, *Larus delawarensis*.

Strychnine is a commonly used rodenticide and has been used as an avicide for control of species such as the pigeon (Redig et al., 1982). Strychnine poisoning is the most common toxicosis in domestic dogs in many areas (Blakley, 1984). There are few reports of strychnine poisoning of wild birds. In Saskatchewan, strychnine is registered for control of several "pest" species, including Richardson's ground squirrels (*Spermophilus richardsoni*) and northern pocket gophers (*Thomomys talpoides*) on agricultural land. For this purpose, a 2% solution of strychnine is available commercially to be mixed with grain to provide a final concentration of 2.5 mg strychnine/g dry grain bait. Directions on the container advise placing 5–15 g of treated seed into rodent burrows, and warn against leaving treated grain on the surface where it would be available to non-target wildlife.

On the morning of 17 June 1986 the carcass of an adult female mallard (*Anas platyrhynchos*) and of an adult male ring-billed gull (*Larus delawarensis*) were submitted to the diagnostic laboratory, Department of Veterinary Pathology, Western College of Veterinary Medicine. These were free-flying birds that had been found dead on the edge of a pond within a large waterfowl compound at a local zoo. The zoo is located on the outskirts of Saskatoon and is surrounded on three sides by agri-