

## Trace Elements in Tissues of Marine Mammals from the Alaskan Arctic Archived in the US National Biomonitoring Specimen Bank

Elizabeth A. Mackey, Rabia Demiralp, Paul R. Becker, Robert R. Greenberg, Stephen A. Wise

Analytical Chemistry Division, National Institute of Standards and Technology, Gaithersburg, MD USA 20899

The National Biomonitoring Specimen Bank (NBSB) is located at the National Institute of Standards and Technology in Gaithersburg, MD. Through collaborations with several different US agencies, a diverse array of specimens that represent the status of the environment at the time of collection has been collected in a clean, well-documented manner, and archived in freezers that are maintained at liquid nitrogen vapor temperatures. All specimens were divided into two sub-samples and stored in two separate freezers. One subsample, labeled A, is intended for very long term storage and the other (labeled B) may be used for analyses shortly after collection. A subset of the B portions of these specimens is analyzed at NIST using instrumental neutron activation analysis (INAA) to determine baseline concentrations of trace and minor elemental constituents of the specimens and to look for any general trends in the environment.

The National Oceanic and Atmospheric Administration (NOAA) maintains a marine mammal tissue bank within the NBSB as part of the US Marine Mammal Health and Stranding Response Program. The holdings of this bank include liver, kidney, and blubber (and in some cases muscle and serum) specimens from 350 individual marine animals representing 25 different species. Over the past ten years, specimens from 12 species (250 animals) were taken during Native American subsistence harvests in the Alaskan Arctic. These Alaskan species, the number of animals, and specimens from each are listed in Table 1. Subsamples of the liver tissues of 25 beluga whales (*Delphinapterus leucas*), 13 ringed seals (*Phoca hispida*), 5 bowhead whales (*Balaena mysticetus*), and three bearded seals (*Erignathus barbatus*) were analyzed using INAA. Subsamples of kidney tissues of 10 beluga whales also were analyzed.

Table 1. Inventory of the NOAA Marine Mammal Tissue Bank for Species from Alaska.

Species	Number Sampled	Liver	Kidney	Blubber	Muscle	Serum
Bearded Seal	10	9	8	10	0	0
Elephant Seal	1	1	1	1	0	0
Harbor Seal	10	9	9	8	1	0
Northern Fur Seal	21	21	21	21	5	6
Ringed Seal	57	47	47	57	0	0
Spotted Seal	2	2	2	2	0	0
Stellar Sea Lion	4	3	4	4	0	0
Beluga Whale	45	41	40	43	17	0
Bowhead Whale	48	43	6	48	0	0
Walrus	20	20	20	17	0	0
Polar Bear	28	27	27	18 (fat)	0	0
Sea Otter	3	3	3	0	0	2
<b>Total</b>	<b>249</b>	<b>226</b>	<b>188</b>	<b>229</b>	<b>23</b>	<b>8</b>

Using INAA, concentrations of the following elements were determined: Ag, As, Br, Ca, Cd, Cl, Co, Cu, Cs, I, Hg, K, Mg, Mo, Mn, Na, Rb, Sb, Sc, Se, Zn, V; concentrations of the following elements were below the INAA detection limits for most of these tissues: Au, Ba, Ce, Eu, Hf, La, Sm, Sn, Sr, Ta, Tb, Th, U. The data were analyzed to determine: which elements accumulate in the animal with age; whether there are differences among the Alaskan species; whether there are differences within a species based on geographic location; whether there are differences between Alaskan mammals and those from other regions. Element concentrations found in the tissues of these animals were compared with those reported by other researchers for the same species.

To determine whether these elements were increasing in the liver as a function of age, hepatic element concentrations were plotted against age estimates for 12 beluga whales from Point Lay and Point Hope and 8 from Cook Inlet. The two groups were evaluated separately because they are separate populations with very different growth characteristics. Age estimates were based on the number of growth layer groups in the teeth of these animals and were determined by Robert Suydam [1] and Barbara Mahoney (unpublished data). No age estimates were available for the other species, so animal length was used as an indication of animal age. Elements for which hepatic concentrations increased with the age of the Point Lay and Point Hope beluga whales were V, Se, Ag, Cd, and Hg. No increases with animal age or length were observed for the Cook Inlet population. Hepatic concentrations of V, Se, Cd, and Hg increased with length of the ringed seals. Hepatic V, Se, Ag, and Hg increased with length of the three bowhead whales that were studied and V, Se, and Ag increased with the length of the three bearded seals studied. For bowhead whales and bearded seals the numbers of animals studied are too few to make any conclusions concerning the trace element status of these species.

One striking difference among the Alaska species is the levels of silver found in beluga whales as compared with levels found in the other species. This was first observed during the analysis of the first ten beluga whales from Point Lay and Point Hope regions of Alaska [1]. An additional ten beluga whales from Cook Inlet Alaska were analyzed for this work and Ag concentrations were similar to those measured in the Point Lay and Point Hope animals. It is believed that the animals from Cook Inlet are a distinctly different population from the Point Lay and Point Hope population. Levels in the liver tissues of beluga whales are generally orders of magnitude greater than those found in other species, with concentrations ranging from 10 to 107  $\mu\text{g/g}$  (of tissue wet weight). This magnitude of accumulation of silver may be unique to this species.

No significant differences in trace element levels were found within a species as a function of geographic location. Hepatic V in Cook Inlet beluga whales (0.02-0.06  $\mu\text{g/g}$ ) was somewhat lower than in the beluga whales from Point Hope and Point Lay (0.03-0.3  $\mu\text{g/g}$ ) but the Cook Inlet population was on average younger than the other group. Among different species from different regions, one significant difference were the levels of V found in Alaskan species as compared with those found in species from other locations [2]. Vanadium concentrations in the liver of ringed seal, bowhead whales, bearded seals, and beluga whales of both populations ranged from about 0.03 to 1  $\mu\text{g/g}$ . These levels are much higher than those found in pilot whales and harbor porpoise, from the Eastern US for which values were 0.02  $\mu\text{g/g}$  [3], but similar to those reported by Frank et al. [4] in the livers of pinnipeds from Swedish waters and those reported by Warburton and Seagars [5] for walrus livers.

- [1] Becker, PR, EA Mackey, R Demiralp, R Suydam, G Early, SA Wise, BJ Koster. *Mar Poll, Bull*, 30: 262-271, 1995.
- [2] Mackey, EA, Becker PR, Demiralp R, Greenberg RR, Koster BJ, Wise SA. *Arch Contam Toxicol*. 30: 503-512, 1996.
- [3] Mackey EA, Demiralp R, Becker PR, Greenberg RR, Koster BJ, Wise SA. *Sci Total Env* 175: 25-41, 1995.
- [4] Frank A, Galgan V, Roos A, Olsson M, Petersson LR, Bignert A. *Ambio* 21: 529-538, 1992.
- [5] Warburton, J, DJ Seagars. USFWS Technical Report R7/MMM 93-1. Anchorage, AK, 1993.