



Regional differences in total mercury content of Aleutian harbor seal fur

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Background

Across Alaska, regional differences have been found in Steller sea lion (SSL) fur total mercury concentration ([THg]) with the greatest [THg] found in the Western Aleutian Islands (WAI). Within the WAI region, increased [THg] are associated with foraging at higher trophic level in Steller sea lions (Rea et al., 2013).

Within the Aleutian Islands both harbor seals and SSL populations have declined through the 1980's and 1990's, with the most dramatic harbor seal declines seen in the WAI (86%) and CAI (66%) (Small et al. 2008).

Consumption of high levels of mercury results in neurochemical changes that can impact mammalian health, reproduction, and individual survival (Basu et al. 2006).

Previous studies have suggested that Steller sea lions from the western distinct population segment (wDPS) may have higher exposure to mercury via their diets as compared to animals sampled in other regions (Holmes et al. 2008). However, little information exists for harbor seals.

Objectives & Hypotheses

The objective of this study was to examine the [THg] of harbor seal fur in the Central (CAI) and Eastern (EAI) Aleutian Islands and to examine [THg] relationship with trophic level to determine if similar trends in [THg] are observed in sympatric pinniped species.

Hypothesis 1: [THg] will be greater in adults (males) compared with all other age and sex groups.

Hypothesis 2: [THg] will be positively correlated with trophic level estimated using $\delta^{15}\text{N}$.

Hypothesis 3: [THg] will be similar among pinniped species within a given region.

Methods

The [THg] of fur was quantified from Eastern (EAI; n=26) and Central Aleutian Island (CAI; n=20) harbor seals using a Milestone direct mercury analyzer (DMA-80) to determine if regional differences exist. In addition, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ stable isotope ratios were quantified in fur to assess [THg] in a trophic level context.

Acknowledgements

In Memoriam: this project could not have been completed without the dedicated and diligent laboratory work of our undergraduate research assistant, Tiffany Lamken. This laboratory research was supported through a NOAA Cooperative Research Award to UAF (NA15NMF4390168). We thank the Marine Mammal Laboratory Polar Ecosystems field team for collection of samples and financial support of field work conducted under MMPA Permit 15126 (issued to NOAA Fisheries/MML).

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Results

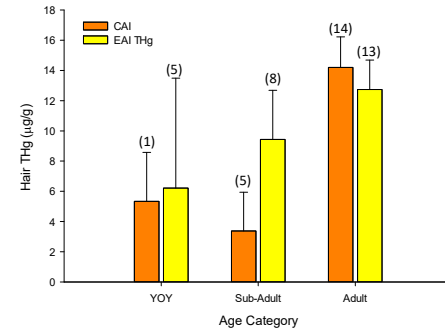


Figure 1. Total Mercury Content of Fur

- AGE: Adults have greater mean (± standard error) [THg] ($13.77 \pm 1.41 \mu\text{g/g}$) compared with young of the year (YOY, $4.81 \pm 4.47 \mu\text{g/g}$) and sub-adult ($5.56 \pm 2.41 \mu\text{g/g}$; $p = 0.015$) harbor seals. Sample size indicated in parentheses above bar.
- SEX: No sex differences in [THg] were observed ($p = 0.448$).
- REGION: No difference was found between fur [THg] in CAI ($9.46 \pm 2.81 \text{ ppm}$) and EAI ($7.00 \pm 2.09 \mu\text{g/g}$; $p = 0.413$).

- Importantly, more than 15% of the harbor seals from this study had fur [THg] greater than the $20 \mu\text{g/g}$ threshold of concern (EAI 12%, CAI 20%), and 37% had [THg] above $10 \mu\text{g/g}$ (EAI 35%, CAI 40%).

Age differences in [THg] are similar to observations in other species. Although the mean population values are below the $20 \mu\text{g/g}$ threshold of concern, a substantial proportion of the population have values above this threshold where physiological effects are possible. Further investigation of the effects on populations is needed.

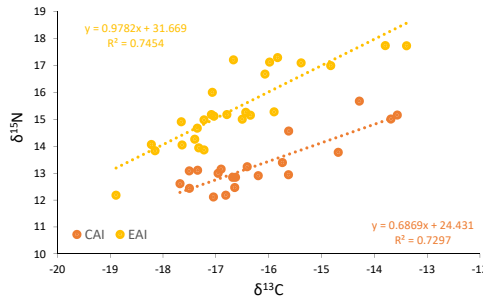


Figure 2. Stable Isotope Ratios in Fur

- AGE: No age differences were observed in $\delta^{15}\text{N}$ values ($p = 0.236$).
- SEX: No sex differences in $\delta^{15}\text{N}$ were observed ($p = 0.675$).
- REGION: Mean $\delta^{15}\text{N}$ was greater in EAI (15.7 ‰) compared with CAI (13.2 ‰; $p < 0.001$).
- There is a significant positive linear relationship with $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ for both populations ($p < 0.05$).

Diet and THg

- No correlation was observed between [THg] and trophic level ($p = 0.96$) estimated using $\delta^{15}\text{N}$ values in either region (data not shown).

The linear relationship of C and N isotopes within each region is similar to that seen amongst several species of finfish and cephalopods in the Aleutian islands (Cyr et al. 2016). The different regression lines for each region may reflect different prey assemblages (potentially higher trophic level prey selected in the EAI) or differences in distance that animals forage offshore (to be investigated with related telemetry data).

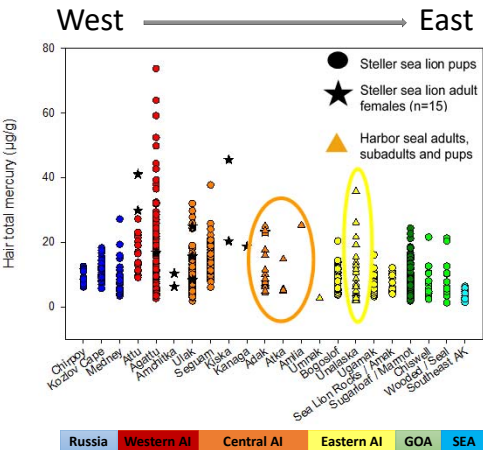


Figure 3. Total mercury content of Aleutian Island (AI) harbor seal and Steller sea lion fur (SSL data presented from Rea et al. 2013)

- The mean [THg] values found in CAI harbor seals (CAI $9.16 \pm 1.58 \mu\text{g/g}$ THg) is similar to those observed in CAI SSL ($10.66 \pm 0.72 \mu\text{g/g}$ THg; $p = 0.521$).
- EAI harbor seals exhibited higher concentrations ($11.59 \pm 1.80 \mu\text{g/g}$ THg) with greater variance ($\sigma = 77.6$) in [THg] compared with EAI SSL (7.49 ± 0.66 , $\sigma = 8.5$; $p = 0.016$).

Patterns of [THg] are not consistent across regions and species. Species specific measures must be completed to accurately assess potential toxic effects for each distinct population segment.

Conclusions

Data from this preliminary study does not support our initial hypothesis. These highlight the importance of regional and species specific measures of toxic effects of heavy metals such as mercury.

Future analyses will include samples collected in 2016 with telemetry and foraging ecology data. Please come see us next year for exciting conclusions.

