Total mercury concentrations ([THg]) were measured in 5 Steller sea lion finfish prey species collected in the eastern Aleutian Islands to determine if the amount and/or variation in mercury in select prey could explain the wide range of [THg] in sea lion pup hair and blood (Castelli et al. 2012, Rea et al. 2013). Alika mackerel (ATMA, Plagiostomus monopterygius), Pacific cod (PACO, Gadus macrocephalus), walleye pollock (WAPO, Theragra chalcogramma), arrowtooth flounder (ARFL, Atheresthes stomias), and Kamchatka flounder (KAF, Aetheseex evermanni) were known or suspected Steller sea lion diet items (Sinclar and Zepplin 2002) and thus were chosen as the first prey species for this preliminary study. Fish samples (20 individuals per species) were collected and donated by Ocean Peace Inc. from winter 2013 commercial operations in fisheries management area 541. Fish were shipped frozen and stored at -20°C until analysis.

The [THg] increased with fork length (fish length) and mass in PACO, KAF, and ARFL (p<0.05) suggesting mercury bioaccumulates with age. PACO and KAF showed significantly higher [THg] than WAPO, ATMA, and ARFL (p<0.05) although no concentrations exceeded 0.18 µg/g, ww. Thresholds of concern for human consumption of fish are 1 µg/g, ww. More enriched stable nitrogen isotope values in PACO and KAF (13.3±0.9 and 12.8±0.3 respectively) suggest that these fish were feeding at higher trophic levels than the ATMA, ARFL, WAPO (10.5±0.4, 11.5±0.5 and 10.5±0.8 respectively) which could explain the slightly higher mercury levels in these two species.

Recent research has shown that high total mercury concentrations ([THg]) occur in the lungfish (natal hair) of young Steller sea lion pups, resulting from exposure of the adult female (dam) to dietary mercury while total hair was grown in utero (Castelli et al. 2012). In addition, research has shown that the highest [THg] were seen in some sea lion pups sampled in the western Aleutian Islands, and that carbon and nitrogen stable isotope values in the whiskers of pups with the highest [THg] indicated that their mothers were feeding on higher trophic level prey species (Rea et al. 2013). This research has generated a great deal of interest in where these sea lions might be feeding on higher trophic level prey species (Rea et al. 2013).

In utero uptake of dietary mercury is thought to play an important role in maternal-fetal mercury exposure and uptake (Castelli et al. 2012). In this study, carbon and nitrogen stable isotope values from maternal plasma, cellular blood, feathers, and adipose tissue fatty acids in Spectacled Eiders (Somateria fischeri) suggested that these were feeding at higher trophic levels than the ATMA, ARFL, WAPO (10.5±0.4, 11.5±0.5 and 10.5±0.8 respectively) which could explain the slightly higher mercury levels in these two species.

The [THg] increased with fork length (fish length) and mass in PACO, KAF, and ARFL (p<0.05) suggesting mercury bioaccumulates with age in these species. PACO and KAF showed significantly higher [THg] than WAPO, ATMA, and ARFL (p<0.05) although no concentrations exceeded 0.18 µg/g, ww. For reference, thresholds of concern for human consumption of fish are 1 µg/g, ww.

Conclusion:

1) In 3 of the 5 prey species (ARFL, KAF and PACO) [THg] linearly increased with length of the fish suggesting that [THg] bioaccumulates with age in these species. It is possible that this relationship would have been seen in the ATMA and WAPO if there were a wider range of fork lengths in our sample. It is possible that only one age class was sampled in this trawl by the fishery.

2) Prey species with higher concentrations of mercury were found to feed at higher trophic levels based on enriched stable nitrogen isotopes, than those species with low concentrations of mercury.

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Literature Cited:


Graphs:

1. Relationship between total mercury concentration and fork length (cm) in 5 Steller sea lion prey species from the eastern Aleutian Islands.

2. Relationship between stable nitrogen isotope (δ15N) and Total Mercury ([THg]) in 5 Steller sea lion prey species in the eastern Aleutian Islands.

Method/Materials:

Sample collection:

Fish samples included 20 individuals from 5 different species: Alika mackerel (ATMA), Pacific cod (PACO), walleye pollock (WAPO), arrowtooth flounder (ARFL), and Kamchatka flounder (KAF). Fish were sampled from winter 2013 commercial fishery operations in the eastern Aleutian Islands (fishery management area 541). Fish were shipped frozen and stored at -20°C until analysis. Samples (1-5 g) were collected from the left flank from each partially thawed fish. Samples were freeze-dried (percent moisture recorded) and homogenized using a Retch Cryomill (Retch Inc, Newtown, PA).

Mercury Analysis:

Approximately 0.001 g of homogenized dried muscle was analyzed in triplicate for total mercury concentrations ([THg]) in each fish using a DMA-80 direct mercury analyzer (Milestone, Inc: Shelton, CT; EPA Method 7473, QA/QC protocol described in Castelli et al. 2012).

Stable Isotope Analysis:

Approximately 0.5 mg of homogenized dried muscle was placed into a tin capsule and sealed for analysis of δ15N levels relative to standards at the Alaska Stable Isotope Facility, University of Alaska Fairbanks (Federer et al. 2012).