Comparison of mercury and arsenic contamination in marine fish from Cook Inlet to Prince William Sound and Gulf of Alaska: The importance of location, size and species

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Objectives:

- Determine levels of elemental contaminants in marine fish from Cook Inlet and other regions in Alaskan waters
- Examine the differences in tissue concentrations and variation between and within species and locations

Background:

- Consumption of fish is the main route of exposure to methylmercury (MeHg) for humans and other piscivorous animals (birds, marine mammals, fish, etc.)
- MeHg is the most toxic form of Hg and it bioaccumulates and biomagnifies in the food chain
- MeHg levels in fish tissue are often correlated with fish size, age, trophic level, and local point sources including geologic and anthropogenic inputs
- Mercury can also be transported long distances on a global scale via atmospheric and oceanic processes
- The health benefits of eating fish low in mercury and high in Omega-3 fatty acids, Se, and other micronutrients is well established (ASMI, 2015)
- The most recent State and Federal recommendations for fish consumption appropriately weigh mercury tissue concentrations against the health benefits of high quality nutrients in fish when developing risk assessment models for human and wildlife consumption.
- Arsenic is naturally present in soil and water and background levels are determined by local geologic sources
- Inorganic arsenic is highly toxic and has been linked to kidney damage, anemia, central nervous system symptoms, developmental disorders, and some cancers (EPA 2007, EFSA 2009).
- Organic forms of arsenic are much less toxic and are the major form found in shellfish and fish as arsenobetaine

Methods:

- Fish were collected between 2001 and 2014 and muscle tissue was analyzed for total mercury, arsenic and selenium at the State Environmental Health Lab following a Quality Assurance Project Plan (Gerlach et al. 2002).
- Means and variation were compared by species and location
- Selenium health benefit values (Kenako and Ralston 2007, Ralston and Raymond 2015) =

$$HBV_{Se} = ((Se - Hg)/Se) \times (Se + Hg))$$

- Age was determined by otolith annuli

Figure 1: Fish were collected within in the shaded areas. PWS = Prince William Sound.

Results:

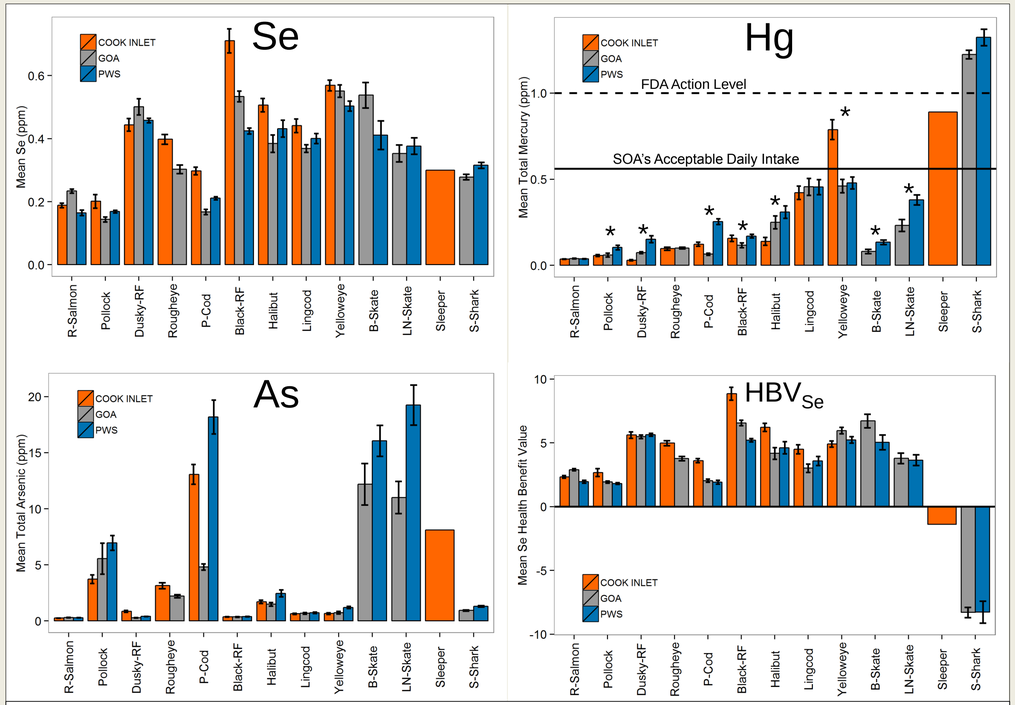

Figure 2: Mean (±SE) values for selenium, total mercury, selenium health benefit values and total arsenic for select species in the Gulf of Alaska, Cook Inlet, and Prince William Sound Alaska. Asterisks indicate significant differences in mercury levels between geographic regions (Kruskal-Wallis H-test, $p<0.05$).

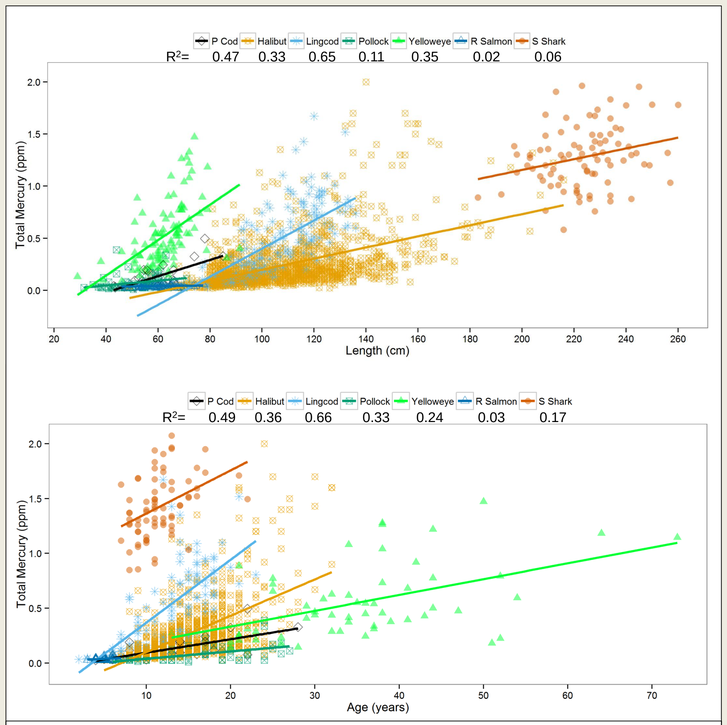

Figure 3: Total mercury in muscle tissue vs. age or length in select marine fish species. Fish were pooled from all three areas.

Conclusions:

- Tissue concentrations of contaminants vary by species and location
- Mercury levels in most fish from Cook Inlet are within safe limits
- Sharks and skates can have high levels of mercury and low selenium Health Benefit Values
- Arsenic levels can be high in some species but is mostly in non-toxic organic forms.

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