Mercury Contamination of Sport Fish in the Delta and Its Tributaries

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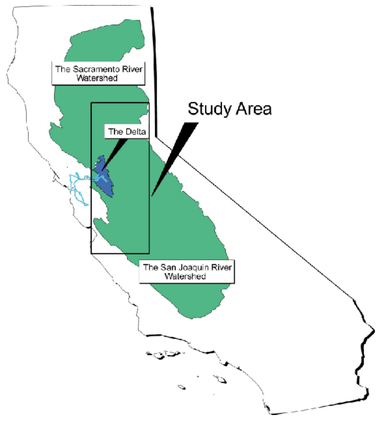


RATIONALE AND APPROACH:

The Sacramento River and San Joaquin River Watersheds in Central California contain mercury pollution resulting from 19th-century mercury and gold mining operations.

In 1998, 1999, and 2000, we sampled 47 sites in the Sacramento River Watershed, the San Joaquin River Watershed, and the Delta for commonly captured sport fish species.

These data will be used to determine whether mercury concentrations in fish used for human consumption are of potential human health concern.

Total mercury concentrations were determined in 446 largemouth bass (*Micropterus salmoides*) muscle tissue samples.

Fish were also analyzed for the following biological attributes: length, age, mass, body condition, and nitrogen and carbon stable isotopes.

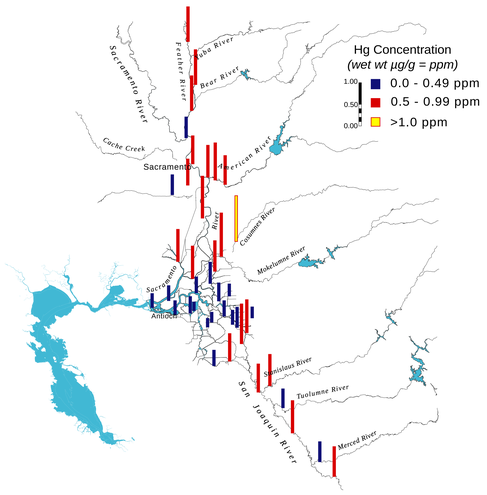
For largemouth bass, in addition to providing information on the risks of human fish consumption, these data address two questions:

1) How do sport fish mercury concentrations vary over space and time in this region?

2) Is this variation due to differences in fish biology or differences in mercury concentrations available to the fish?

SPATIAL VARIATION:

Largemouth Bass Total Mercury Concentration
(All fish are 305-438 mm total length)



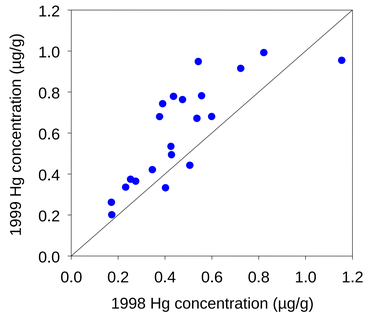
Mercury concentrations in largemouth bass are much lower in the Central Delta than the Sacramento or San Joaquin Rivers.

This pattern is consistent with concentrations in other fish species such as white catfish (*Ictalurus catus*; data not shown).

Historic gold mining sites are generally located in upstream portions of the Sacramento and San Joaquin River Watersheds. Tissue mercury concentrations appear to be higher closer to the original sources.

TEMPORAL VARIATION:

Largemouth Bass Hg In 1999 Versus 1998



In paired comparisons of 21 sites, largemouth bass mercury concentrations were significantly higher in 1999 than 1998 (Sign test, $p < 0.002$).

The dynamic hydrology of the Delta may cause temporal variation in fish mercury concentrations. One hypothesis for the elevated concentrations in 1999 is increased mercury bioavailability due to wetland flooding. A large storm event in 1997 may have caused wetland release of methyl mercury and eventual uptake into fish. This hypothesis is supported by increased prey species mercury concentrations in 1998 (D. G. Slotton, unpublished data) and the increase in 1999 largemouth bass mercury concentrations.

CAUSES OF VARIATION:

Predictor Variable	R^2	p*	Relationship*
Station Only	0.68	<0.001	
Station, Nitrogen Isotope	0.68	0.81	Not Significant
Station, Body Condition	0.68	0.34	Not Significant
Station, Age	0.76	<0.001	Positive
Station, Mass	0.77	<0.001	Positive
Station, Length	0.79	<0.001	Positive

*p value and relationship listed are for the added predictor variable

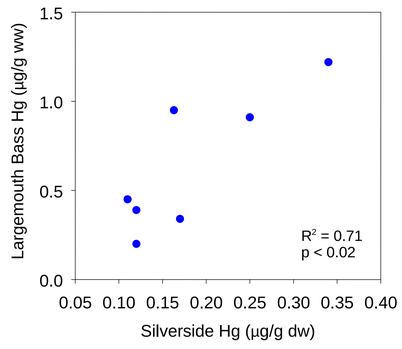
An analysis of covariance was used to determine how much variation in mercury concentrations was associated with fish location versus growth attributes.

Most variation (R^2=0.68) was explained by location alone.

Additional variation was explained by fish length, mass, or age.

Variation in nitrogen isotope signature and body condition did not significantly affect mercury concentrations. This suggests that within stations, fish trophic position or health did not have a detectable influence on mercury concentrations.

Largemouth Bass Versus Inland Silverside Hg

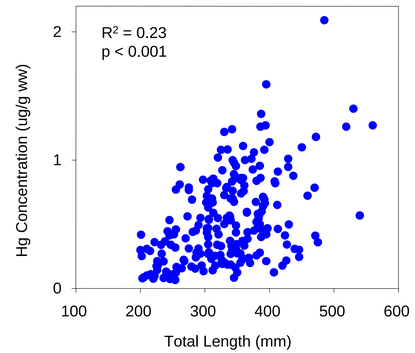


In 7 sites, largemouth bass mercury concentrations were significantly correlated to concentrations in inland silversides *(Menidia beryllina*).

Silversides are lower in trophic position than bass and preliminary stable isotope evidence suggests that they rely on a similar carbon source (contact authors for details).

The correlation between mercury concentrations of these two species suggests that bass concentrations are affected by concentrations of mercury in prey.

Relationship Between Length and Hg in Largemouth Bass



Fish length explains a modest but statistically significant amount of variation in mercury concentrations. (Regression results are for log transformed mercury versus total fish length)

CONCLUSIONS AND FUTURE DIRECTIONS:

There is significant regional variation in sport fish mercury concentrations in the Sacramento and San Joaquin River watersheds.

There also appears to be the potential for significant interannual variation, although additional data are needed to evaluate this further.

Within site variation in trophic position does not appear to be important for mercury concentrations. Evaluations of between site variation in trophic position using baseline corrected nitrogen isotope data should be undertaken.

Preliminary evidence suggests that the majority of variation in largemouth bass mercury concentrations results from variation in mercury bioavailability to prey.

Future comparisons of sport fish concentrations to prey mercury concentrations, sediment mercury concentrations, and site-specific methylation rates should be conducted to further examine this hypothesis.

Additionally, a bioenergetic model of carbon and mercury uptake by largemouth bass should be developed to compare the relative importance of prey mercury concentrations, bass growth rates, and consumption rates in determining bass mercury concentrations.

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