

Seasonal and Sexual Variations of Mercury in Smallmouth Bass (*Micropterus dolomieu*) from the South Fork Shenandoah River, Virginia

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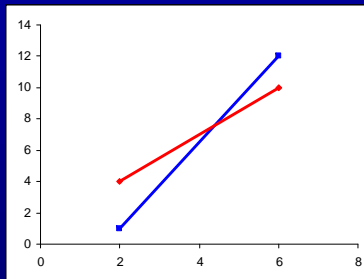


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This presentation evaluates mercury concentrations in smallmouth bass



Background on mercury contamination and mercury monitoring programs



Seasonal and sexual analysis of mercury in smallmouth bass



Management implications of findings



Mercury bioaccumulates in aquatic food webs

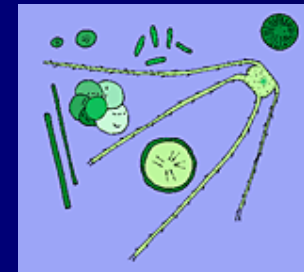
Aquatic Insects
0.1 ppm



Zooplankton
0.01 ppm



Phytoplankton
0.001 ppm



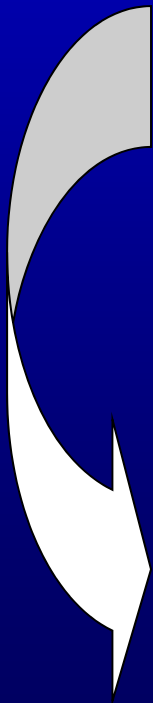
Forage Fish
0.5 ppm



Predatory Fish
4.5 ppm



Avian Predators
125 ppm





Mercury contamination of aquatic ecosystems is increasing

- 1,933 health advisories in the United States
- 115% increase in number of advisories
- 4,120,000 lake hectares and 668,000 river kilometers under health advisory





Mercury monitoring programs rely on accurate fish data

- Manage health advisories
- Track historical trends
- Comparison among waterbodies
 - Shenandoah River basin 100-year mercury monitoring program





Mercury concentrations can differ seasonally and sexually

- Managers tend to overlook season and sex in monitoring programs
- Mercury concentrations can differ seasonally and sexually:
 - Ward & Neumann 1999
 - Nicoletto & Hendricks 1987





100-year monitoring program has inconsistent sampling seasons

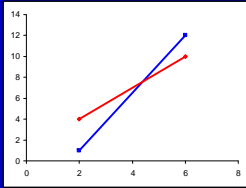
- 100-year mercury monitoring program in the Shenandoah River basin
 - Inconsistent sampling seasons?
 - No indication of fish sex?



Study Objective

Evaluate seasonal and sexual variations of mercury concentrations in smallmouth bass from the South Fork Shenandoah River, Virginia



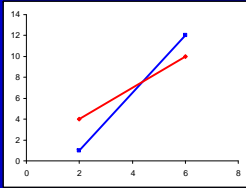


Smallmouth bass was selected as the target fish species

- Selected smallmouth bass
- Extremely abundant
- Popular recreational fishery
- High accumulator of mercury
- Used for the 100-year mercury monitoring program



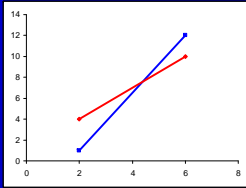




Collected smallmouth bass seasonally by electrofishing

- Collected fish by electrofishing
- Targeted fish ~200 to 300 millimeters total length
- Sampled seasonally
- Followed same methods as the 100-year monitoring program

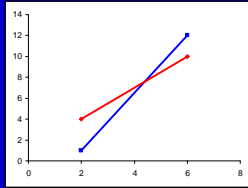




Smallmouth bass were aged by counting otolith annuli

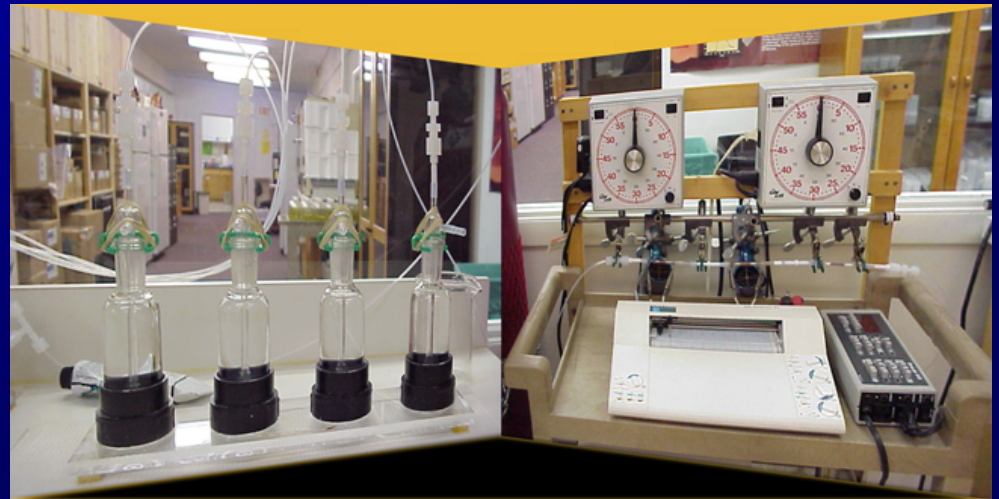
- Removed otoliths for aging purposes
- Viewed submerged with fiber-optic light
- Counted annuli to age

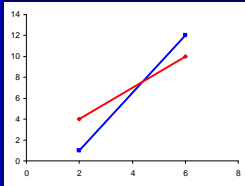




Samples were analyzed by cold vapor atomic absorption

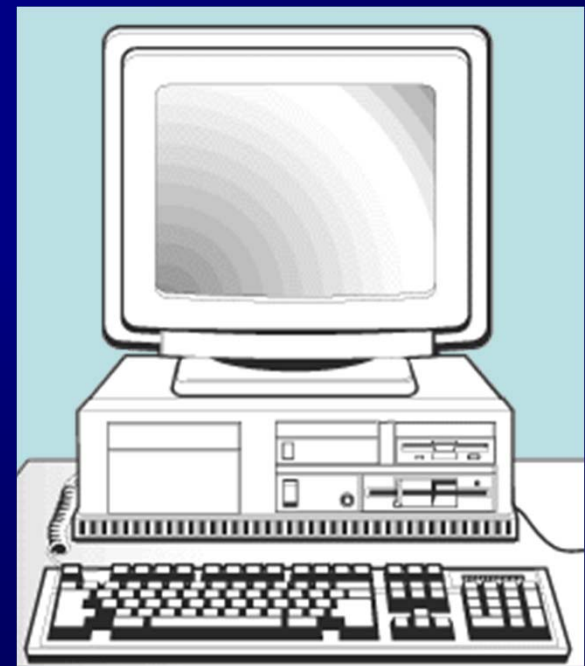
- Division of Consolidated Laboratory Services
- Individual tissue fillets
- EPA method 245.6
- CVAA technique

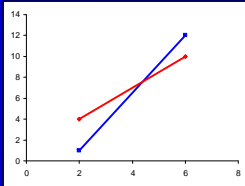




Analyzed mercury data using the analysis of covariance

- Statistical Analysis System 8.2
- Tested data for normality
- Tested slopes for homogeneity
- Tested seasons and sexes using analysis of covariance:
 - mercury: dependent
 - sex & season: independents
 - total length & age: covariates



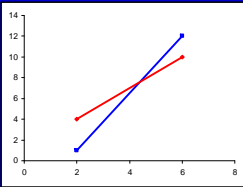


Mercury concentrations were extremely variable

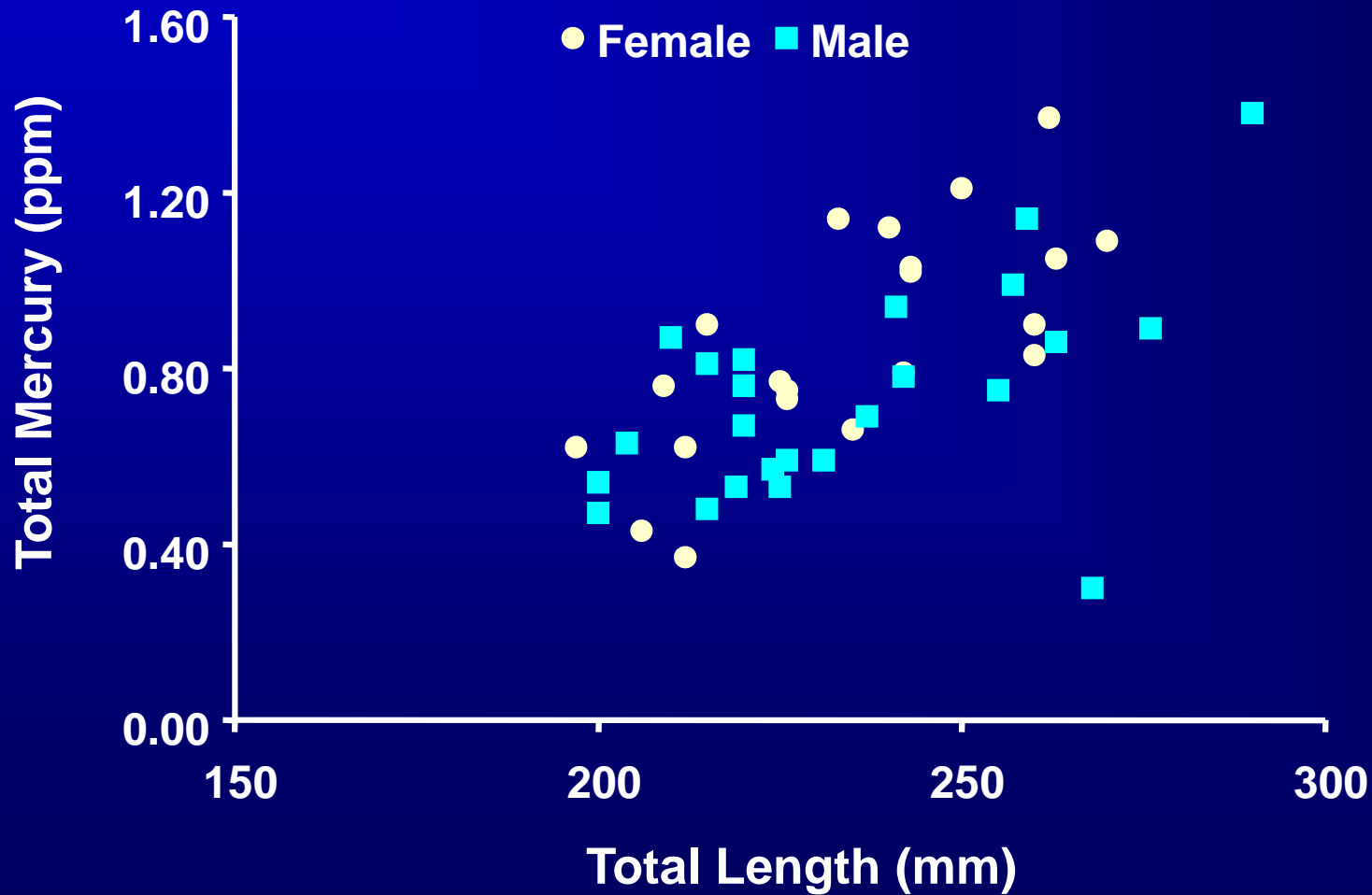
- Collected total of 45 fish
- Fish ranged from 197 to 290 millimeters total length
- Mercury concentrations ranged from 0.30 to 1.38 ppm

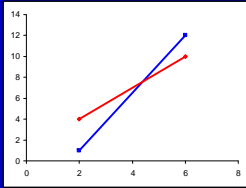


Jenkins & Burkhead 1993



Mercury typically increased with length and age

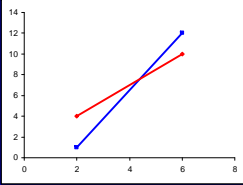




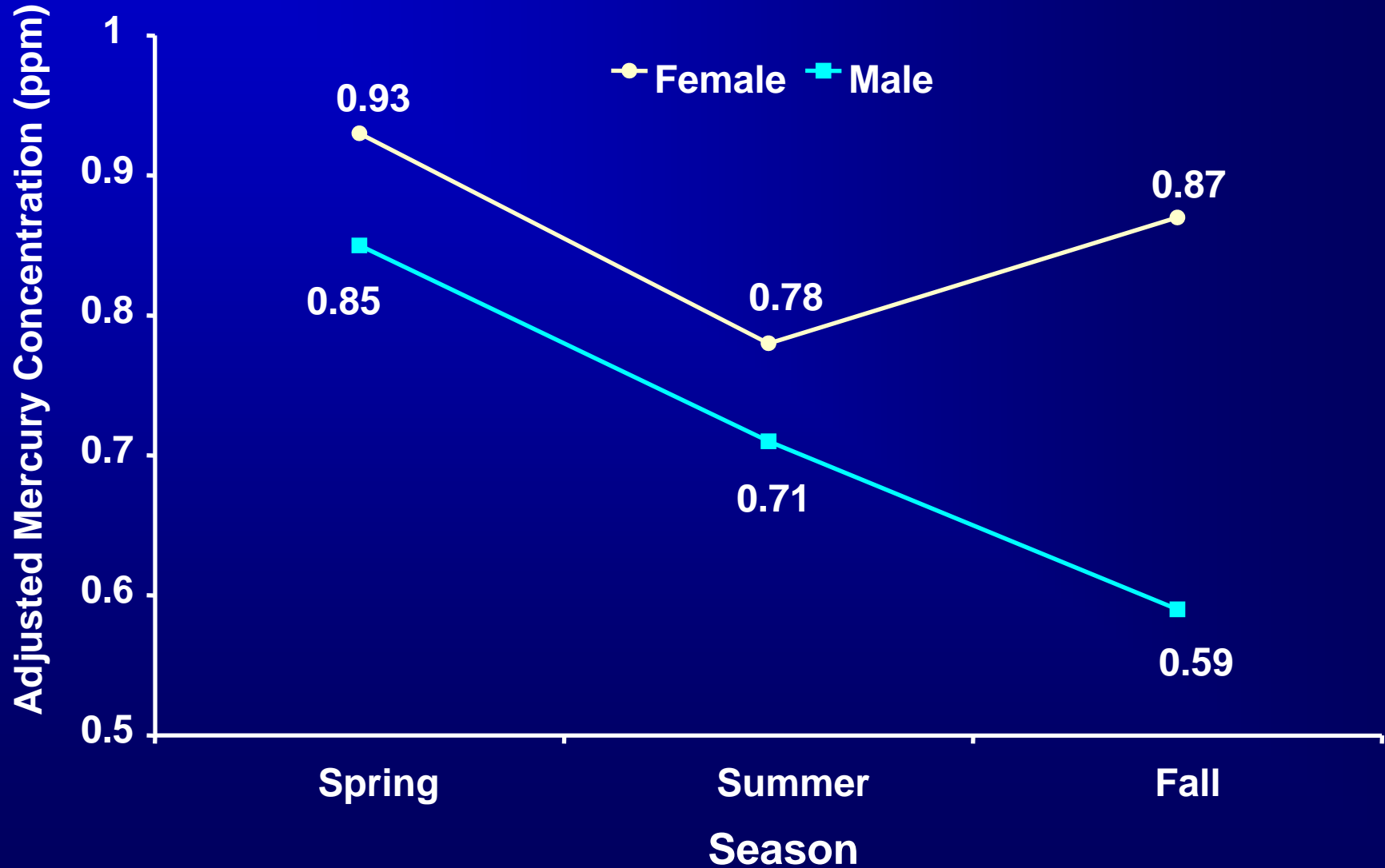
Meaningful interaction was found for sex, season, length, and age

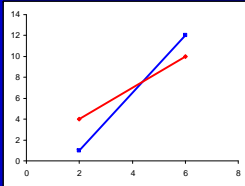
- Analysis of covariance results:
 - Total length & age
 $P < 0.0001$
 - Sex $P = 0.0158$
 - Season $P = 0.0516$





Mercury was higher for females and highest overall in the spring

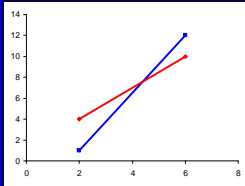




Seasonal changes in mercury may be influenced by feeding rate

- Highest mercury concentrations in spring
- Changes in feeding rates?
- Changes in bioavailability of mercury?





Sexual differences may be caused by reproductive demands

- Highest mercury concentrations in females
- Reproductive demands?
- Changes in feeding rates?





Managers should standardize fish sampling periods

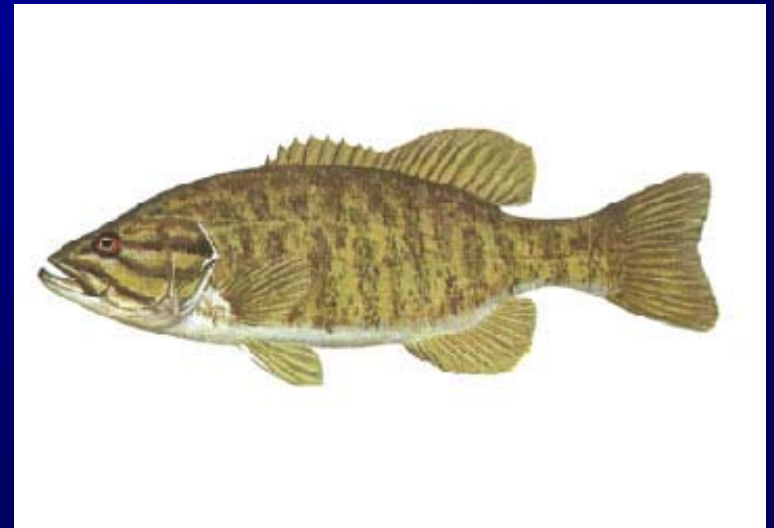
- Standardize sampling periods
- Virginia = **Spring**
- Adjust mercury levels based upon length for comparison





Managers should record sex of fish sampled

- Record sex of fish sampled
- Adjust mercury levels based upon length for comparison
- Adjust for sex?



In summary, mercury concentrations differed between sexes and seasons

- Long-term mercury monitoring programs depend on accurate data
- Smallmouth bass exhibited sexual and seasonal differences in mercury concentration in the South Fork Shenandoah River
- Managers need to standardize sampling periods, record fish sex, and adjust mercury levels accordingly

Acknowledgements



Committee:

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South River Science Team