



# **Effects of Dietary Selenium and Methylmercury on Green and White Sturgeon Bioenergetics in Response to Changed Environmental Conditions.**

**<sup>1,2</sup>Robert C. Kaufman, <sup>1</sup>Ann G. Houck, and <sup>1</sup>Joseph J. Cech, Jr.**

**<sup>1</sup>Wildlife Fish and Conservation Biology, UC Davis**

**<sup>2</sup>Pharmacology and Toxicology Graduate Group, UC Davis**

# **SF Bay-Delta is a multiply-stressed ecosystem**

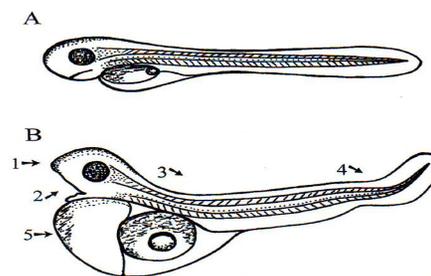
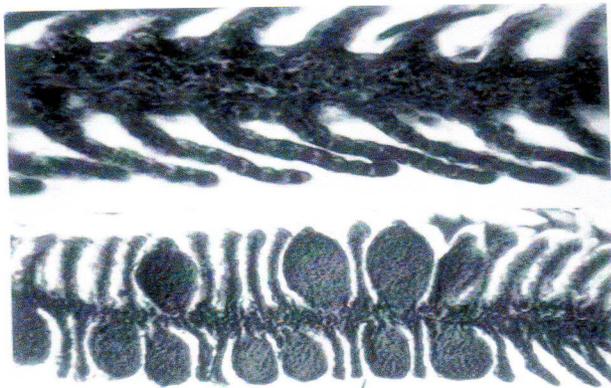
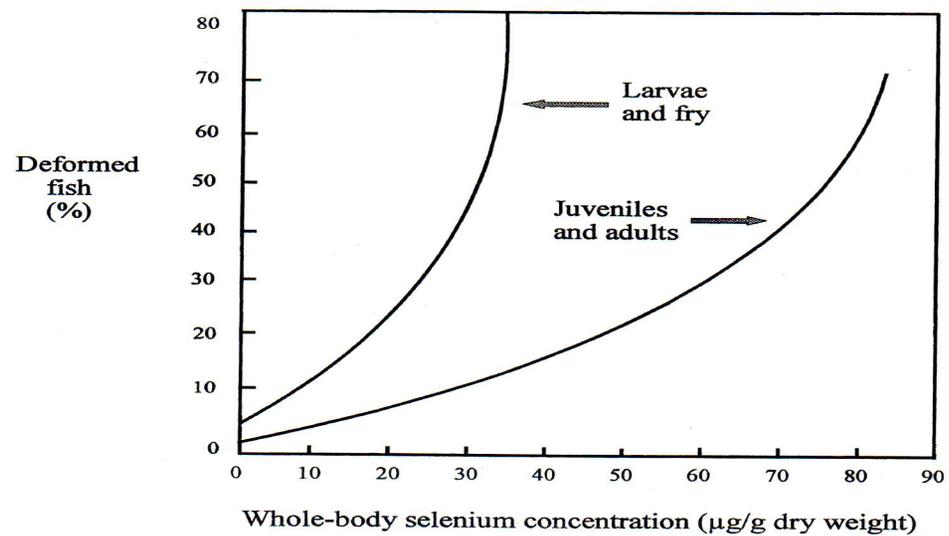
- **Water diversions**
- **Salinity fluctuations**
- **Pollutants e.g., agricultural, industrial, storm-water runoff. Selenium (SeMet) and Mercury (MeHg) are toxicants of concern**
- **Introduced species, e.g., Asian clam**
- **Several species are currently imperiled e.g., POD & salmon**
- **Green and white sturgeon numbers are in decline**
- **Green sturgeon listed as threatened in 2006**

# Problems

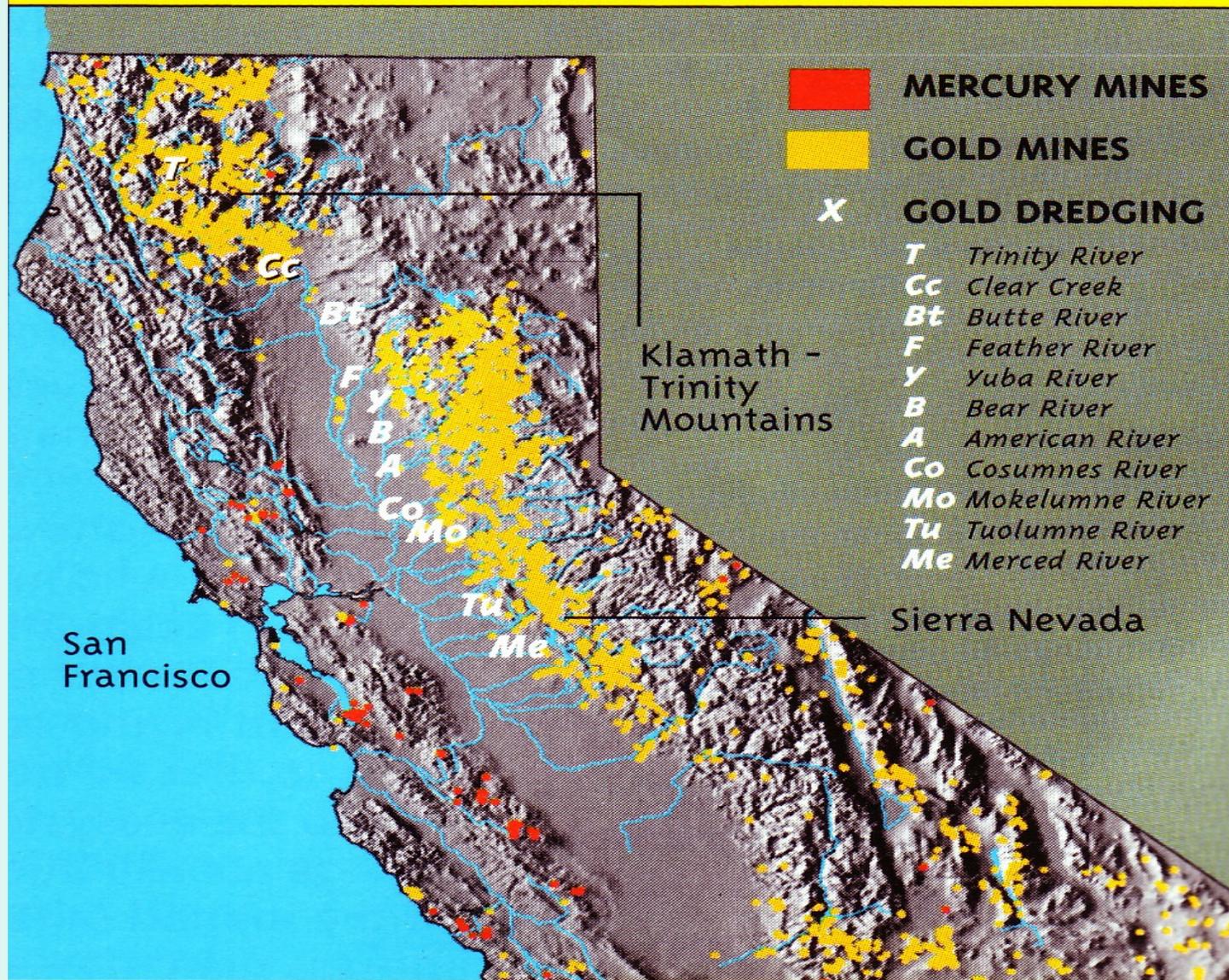
- Little is known of the effects of Hg on wildlife
- Aquatic food web recognized as the most efficient process of bioaccumulation of Hg
- Studies have shown reduced capacity for:
  - Reproduction when exposed as juveniles
  - Growth
  - Ability to avoid predators
  - Shoaling
  - Swimming performance

# Problems cont.:

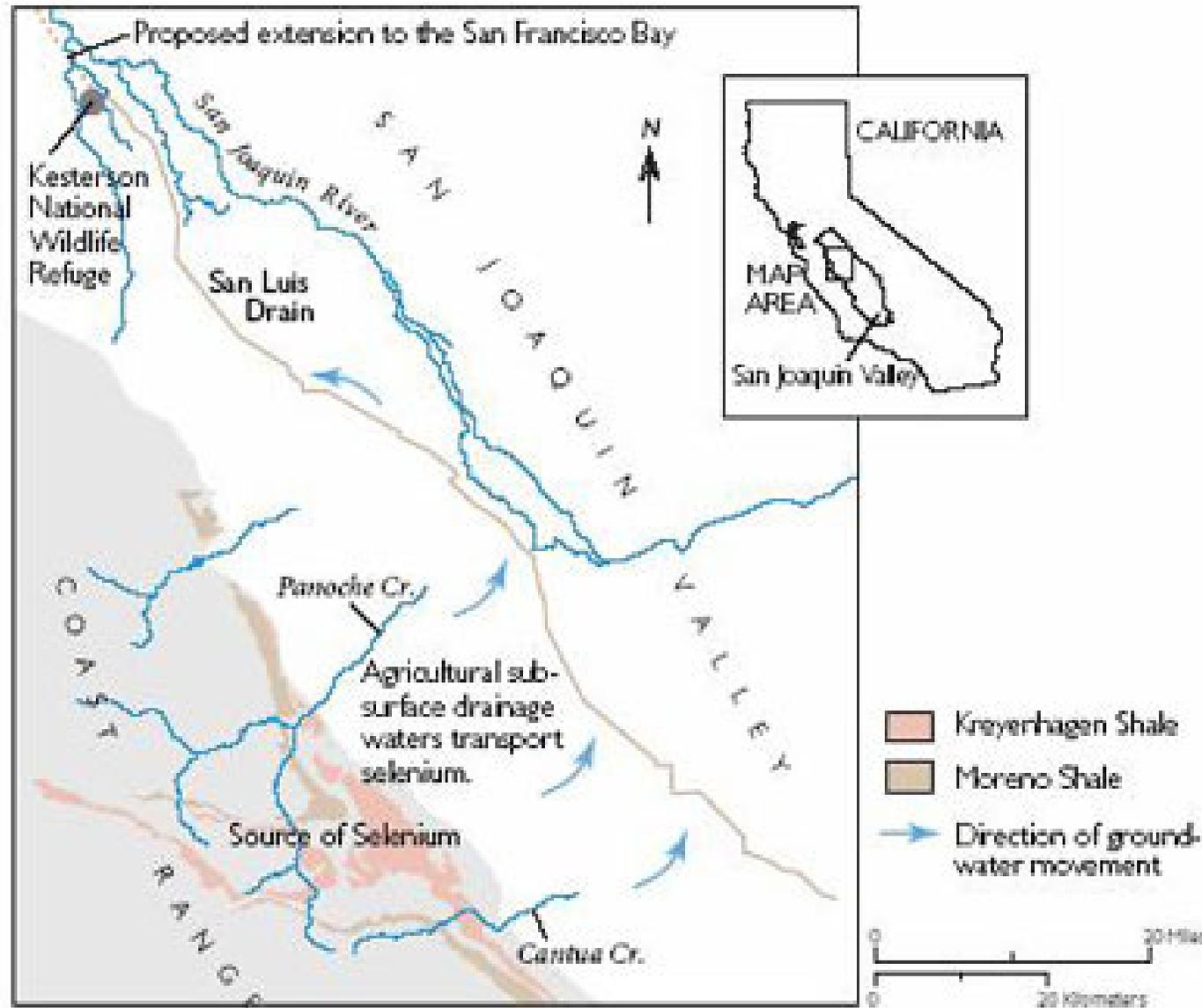
- Selenium: nutritional versus toxicity
- Effects on wildlife well documented
- Studies have shown that Se:
  - Teratogenic in fish and avian species e.g., Belews Lake, NC and Kesterson, CA.
  - Decreased reproduction
  - Concentrations in North SF Bay-Delta are a concern
  - Multiple sources of input e.g., agriculture and refining processes



# NORTHERN CALIFORNIA GOLD AND MERCURY MINES



Source: Alpers, USGS

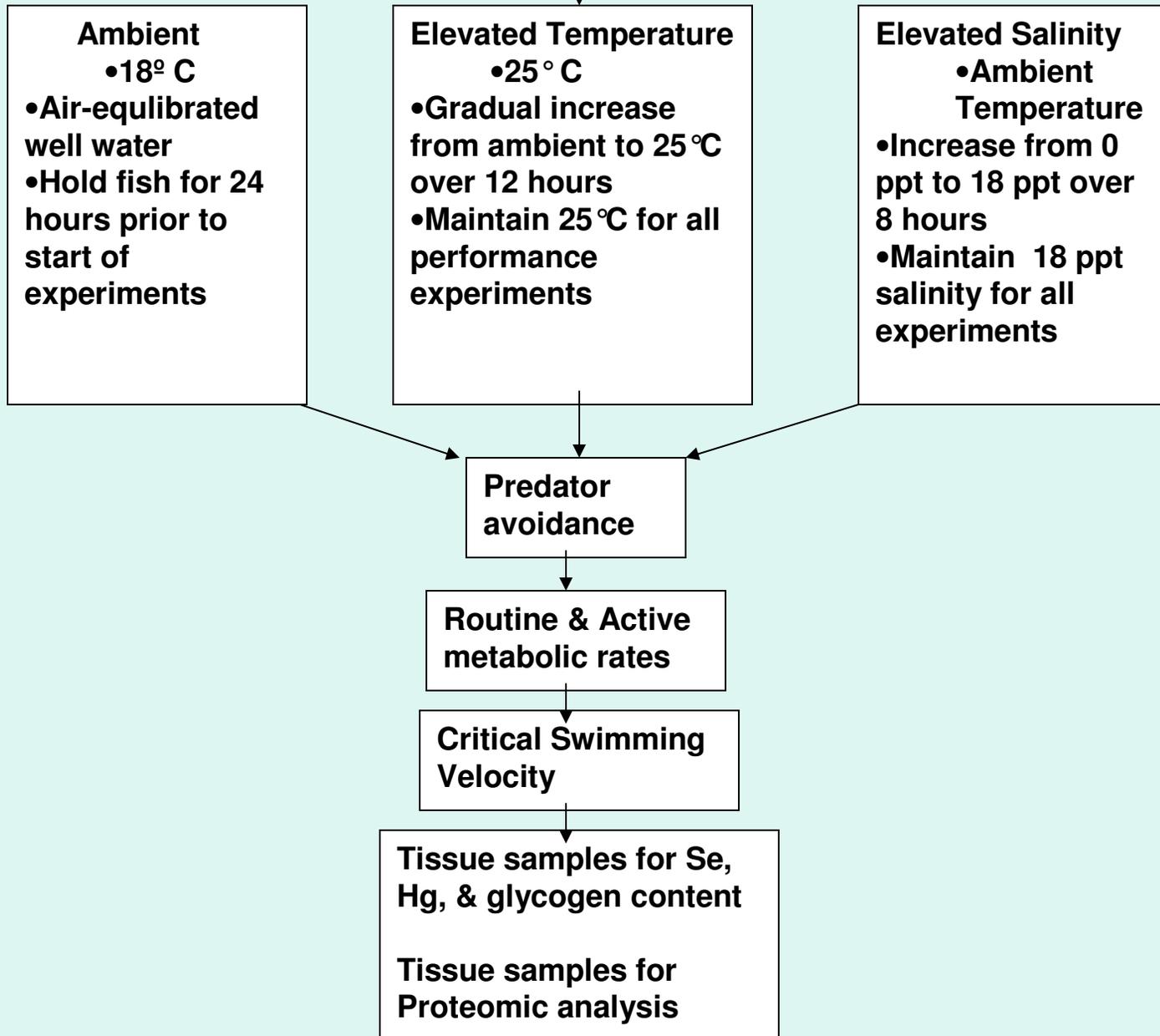


[menlocampus.wr.usgs.gov/.../agriculture.html](http://menlocampus.wr.usgs.gov/.../agriculture.html)

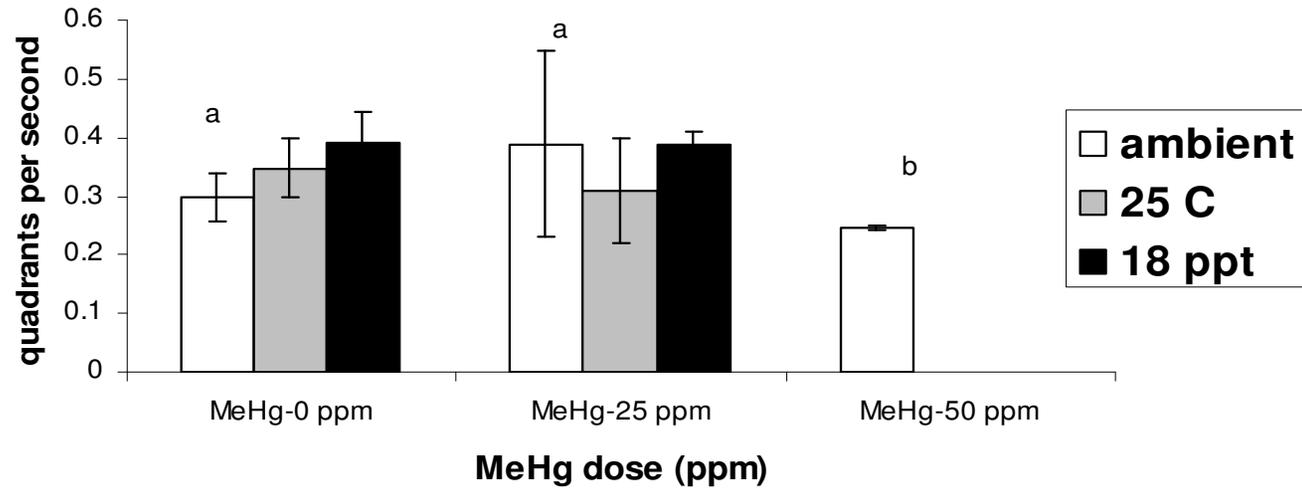
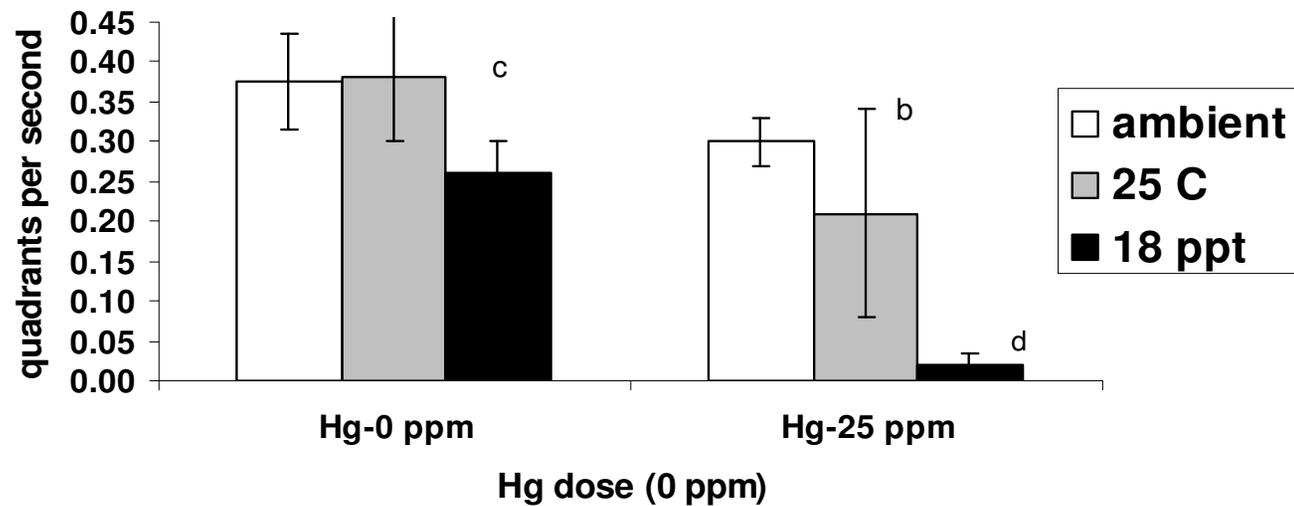
# Objectives

- Determine effects of SeMet and MeHg on sturgeon bioenergetics
- Determine the effects of environmental stressors, temperature and salinity, on previously exposed (SeMet & MeHg) individuals' bioenergetics
- Determine the feasibility of using non-listed, and domesticated white sturgeon as a surrogate for green sturgeon in toxicity testing

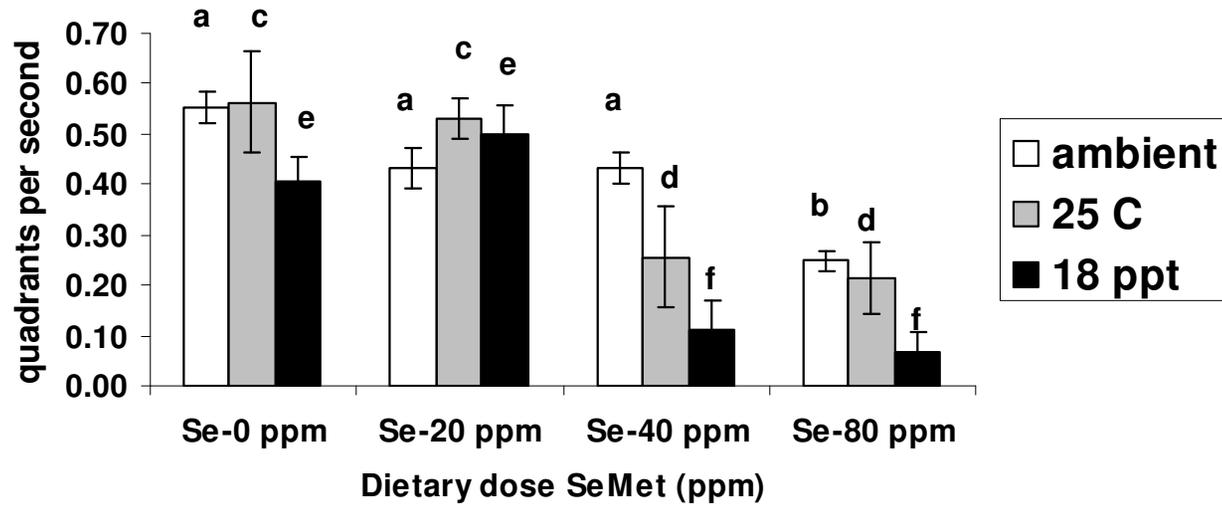
## 56-Day Growth Experiment



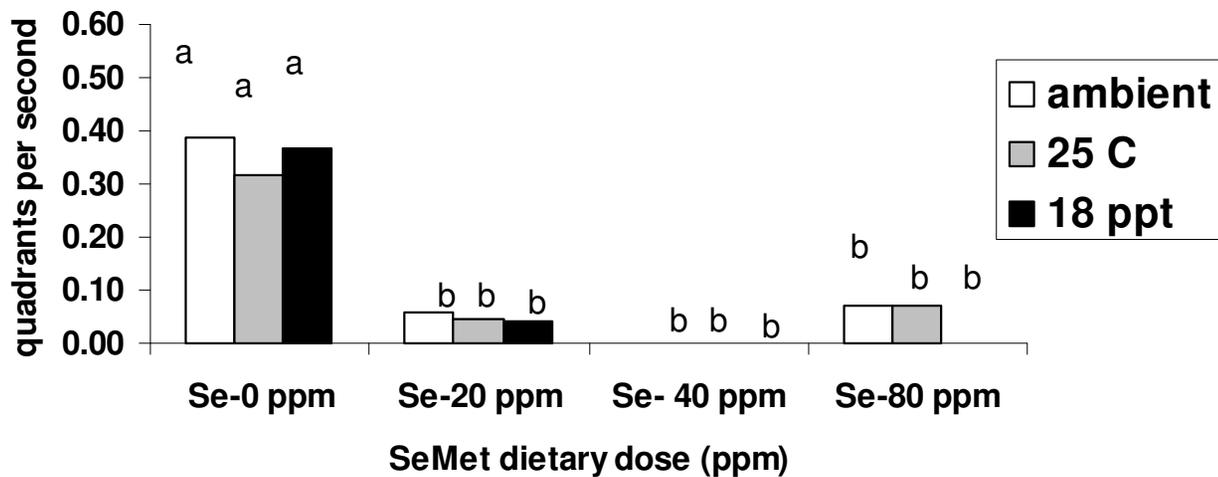


**A****Dietary MeHg effects on white sturgeon predator avoidance****B****Dietary MeHg effects on green sturgeon predator avoidance.**

**A** SeMet effects on simulated predator avoidance in white sturgeon

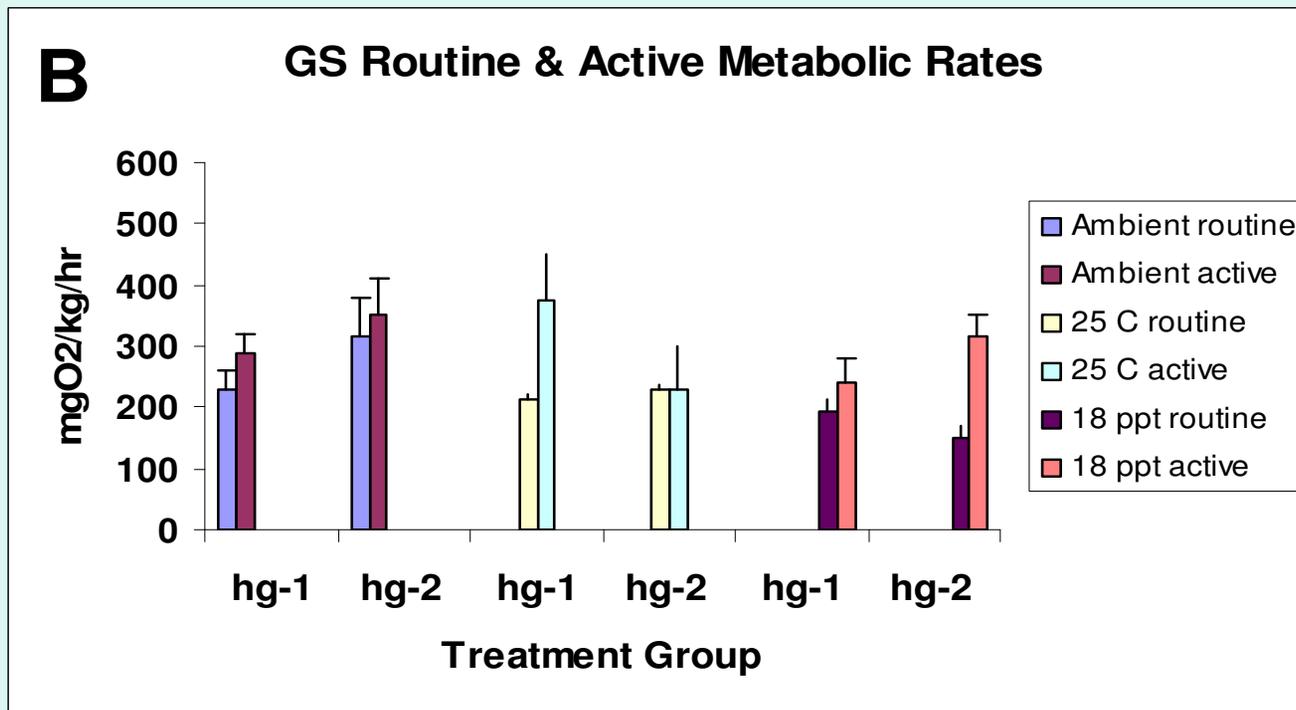
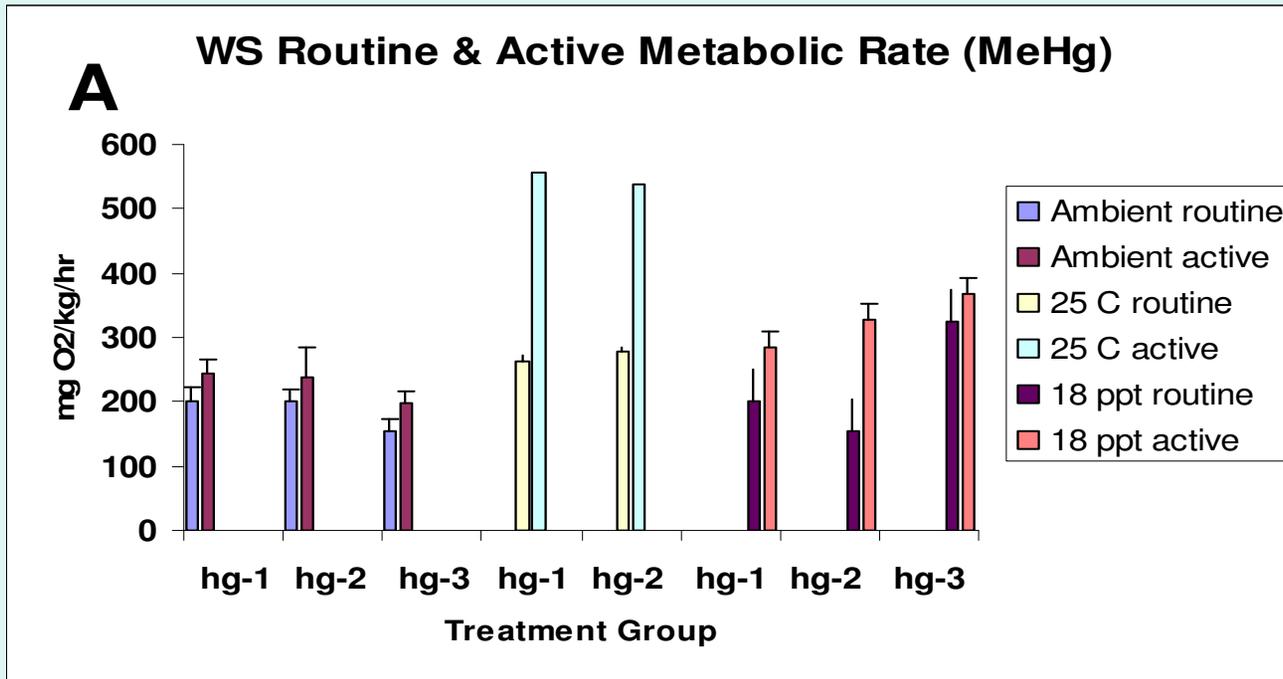


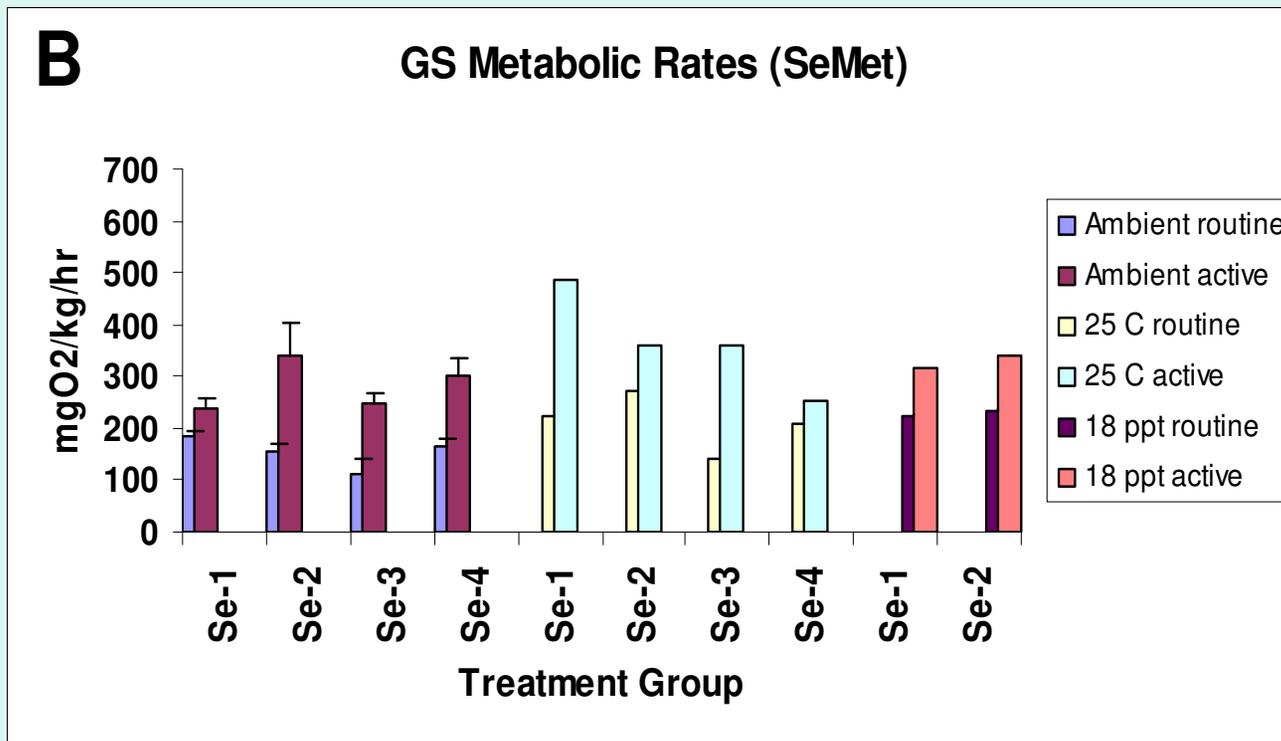
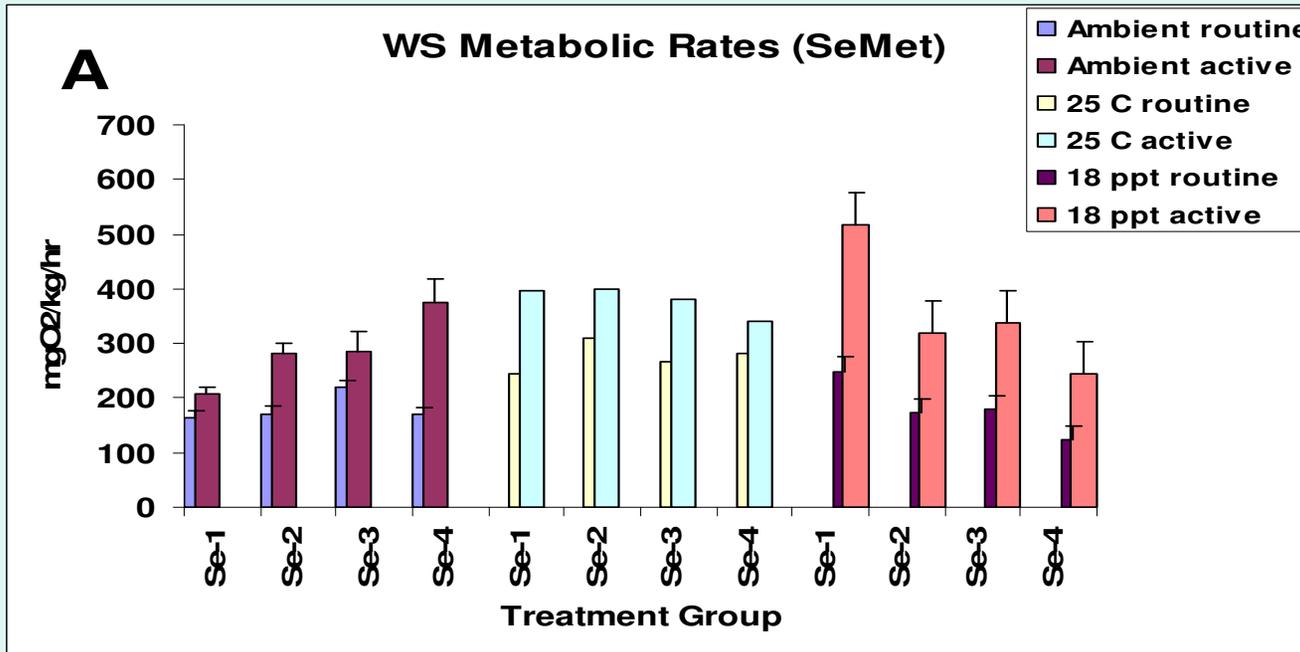
**B** SeMet effects on green sturgeon simulated predator avoidance

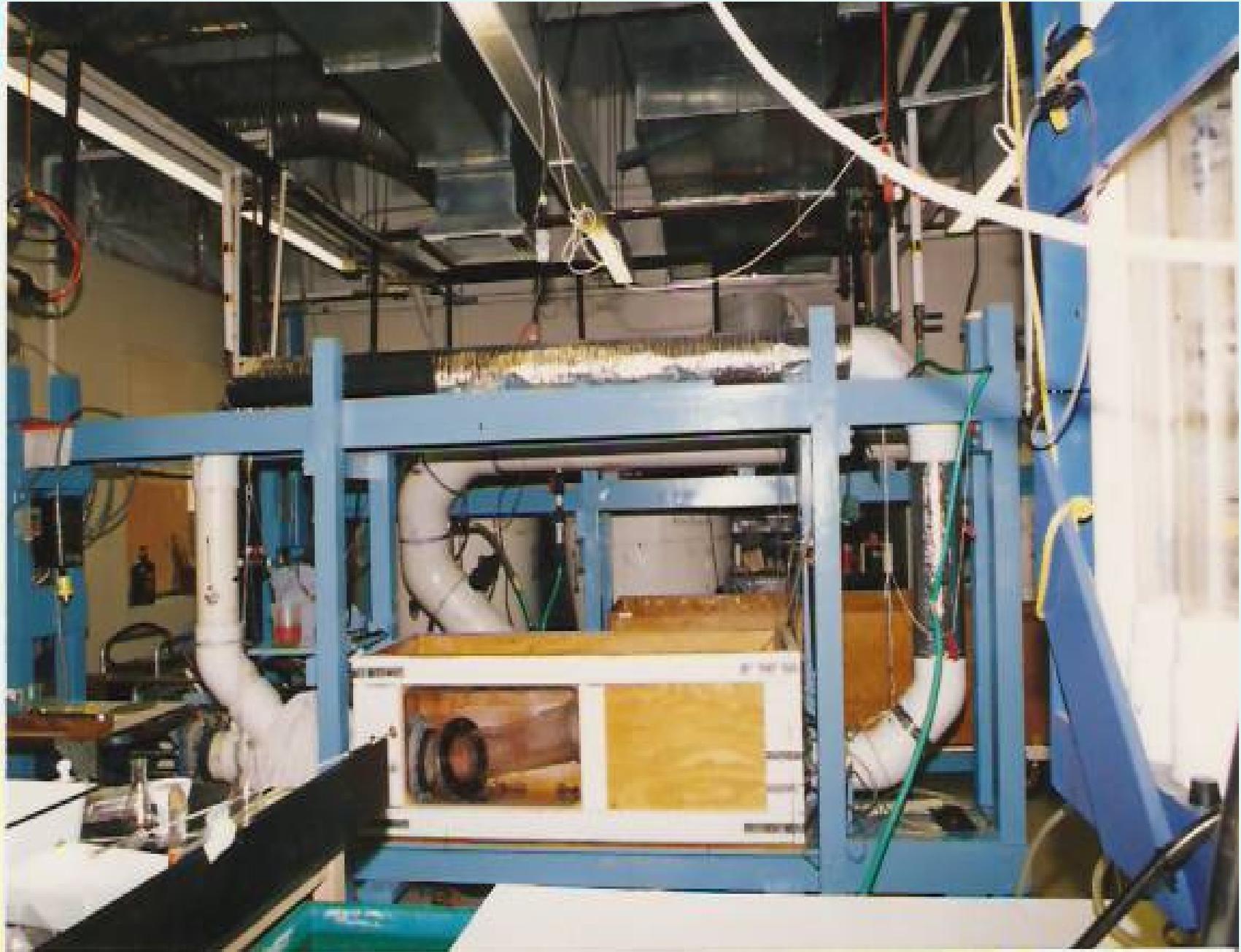




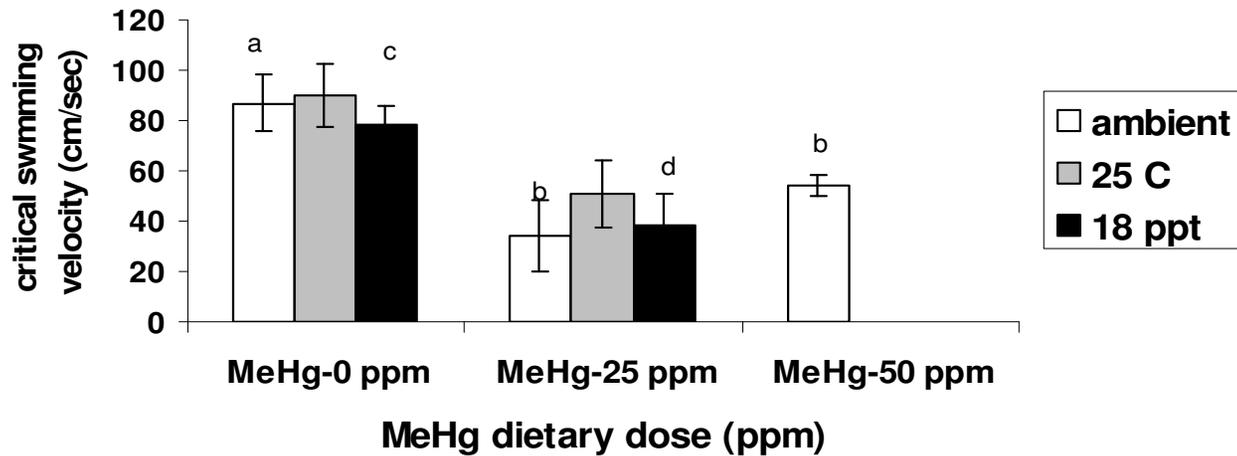
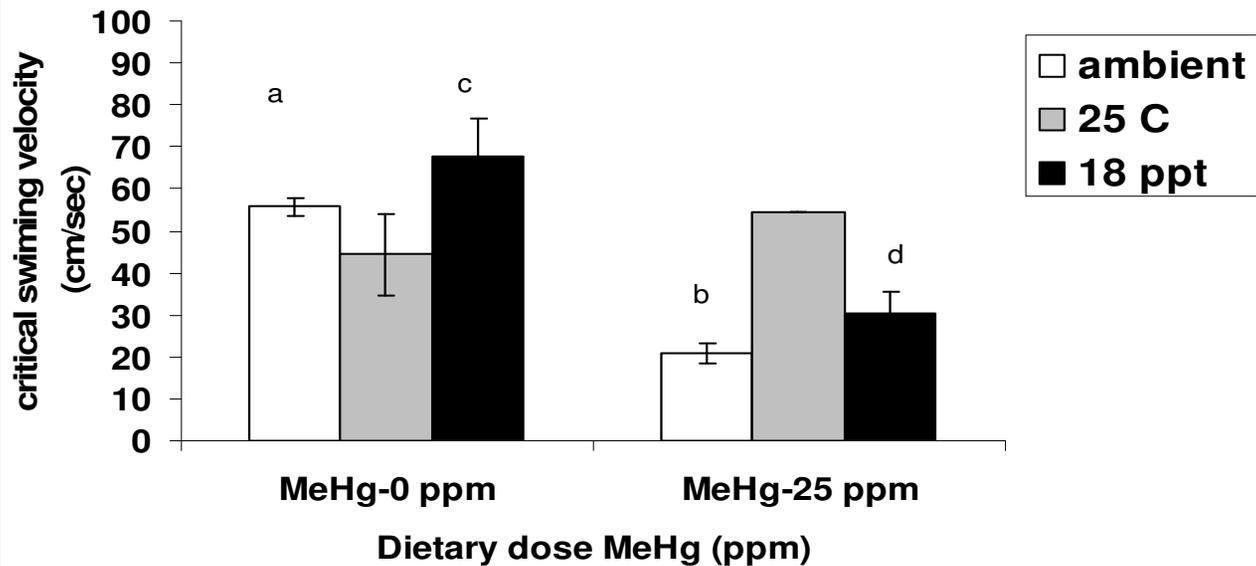
**Routine and  
'active' metabolic  
rates determined  
using Blazka-type  
respirometers after  
the growth expt.**



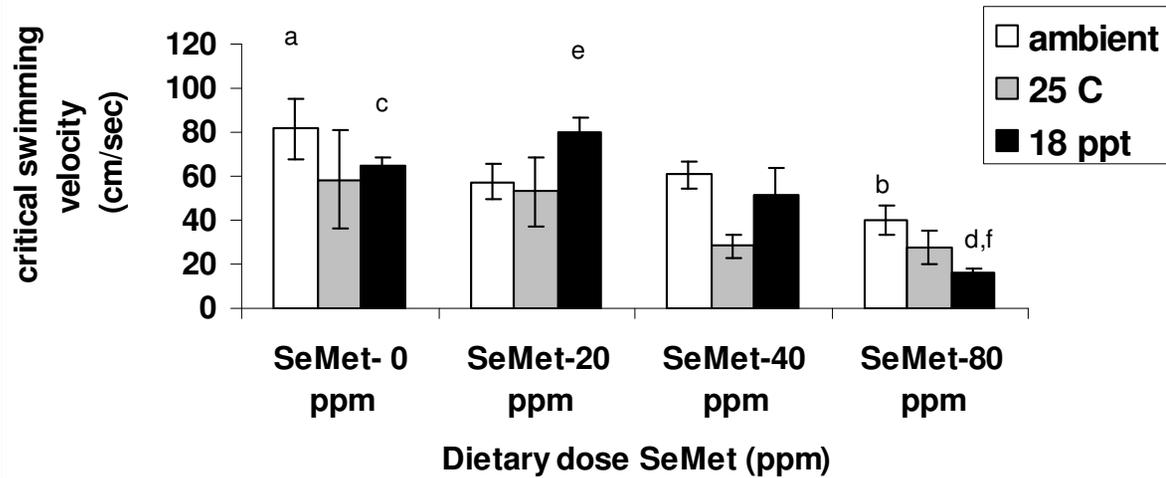




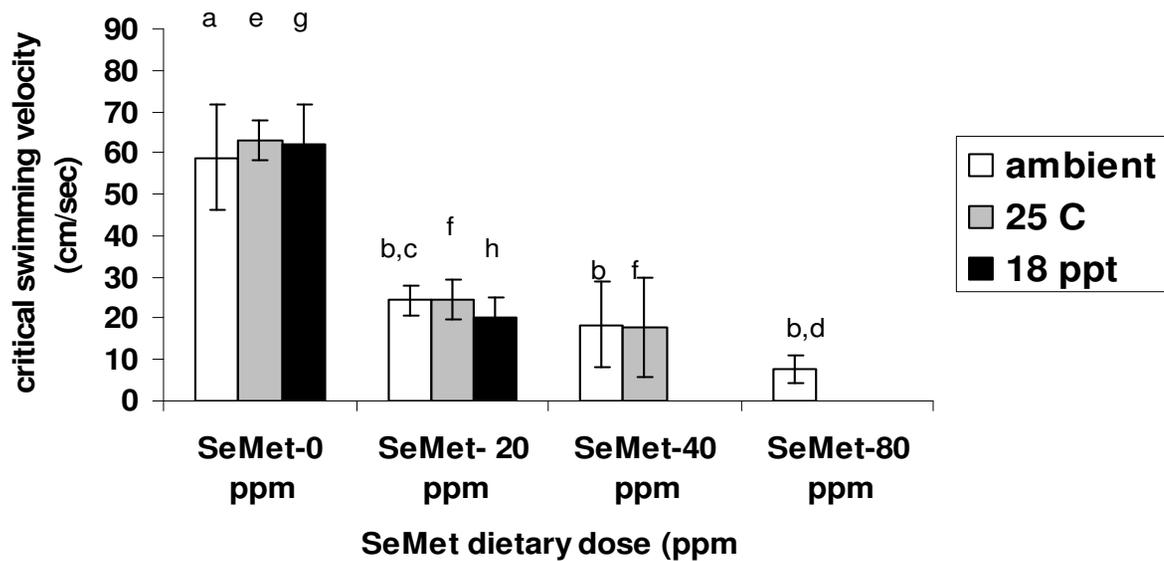


**A****Dietary effects of MeHg on white sturgeon swimming performance****B****Dietary MeHg effects on green sturgeon swimming performance**

**A** Dietary effects of SeMet on white sturgeon swimming performance



**B** Dietary effect of SeMet on green sturgeon swimming performance



# Conclusions

- Significant differences in 'predator' avoidance observed in both species with the most dramatic effect in GS
- Dietary SeMet treatments produced significant decreases in 'active' metabolism in WS at highest dose
- Dietary MeHg treatments produced significant decreases in bioenergetics albeit at very high doses
- Dietary SeMet resulted in significant declines in performance measures in both species with green sturgeon showing a greater sensitivity to this toxicant at all levels tested
- White sturgeon are not an appropriate surrogate for green sturgeon in determining the effects of these toxicants on sturgeon bioenergetics

# Future Course

- Develop reliable source of green sturgeon larvae and juveniles for toxicity testing and tracking studies to determine habitat usage by green sturgeon juveniles, e.g., wild-caught broodstock
- Determine the NOEC of SeMet in green sturgeon juveniles

# Related Posters

- Linares-Casenave, J., et al.....*360*
- Madison\*, R.K., and D. Kueltz.....*368*
- Doroshov, S.I., et al. ....*312*

# Acknowledgements

- We thank CALFED for providing the funding for this study as well as the efforts of Dr. Doroshov's laboratory in development of a captive green sturgeon broodstock program which provided the larvae and juveniles for this study.