

# Reservoir Mercury Control with Hypolimnetic Oxygenation



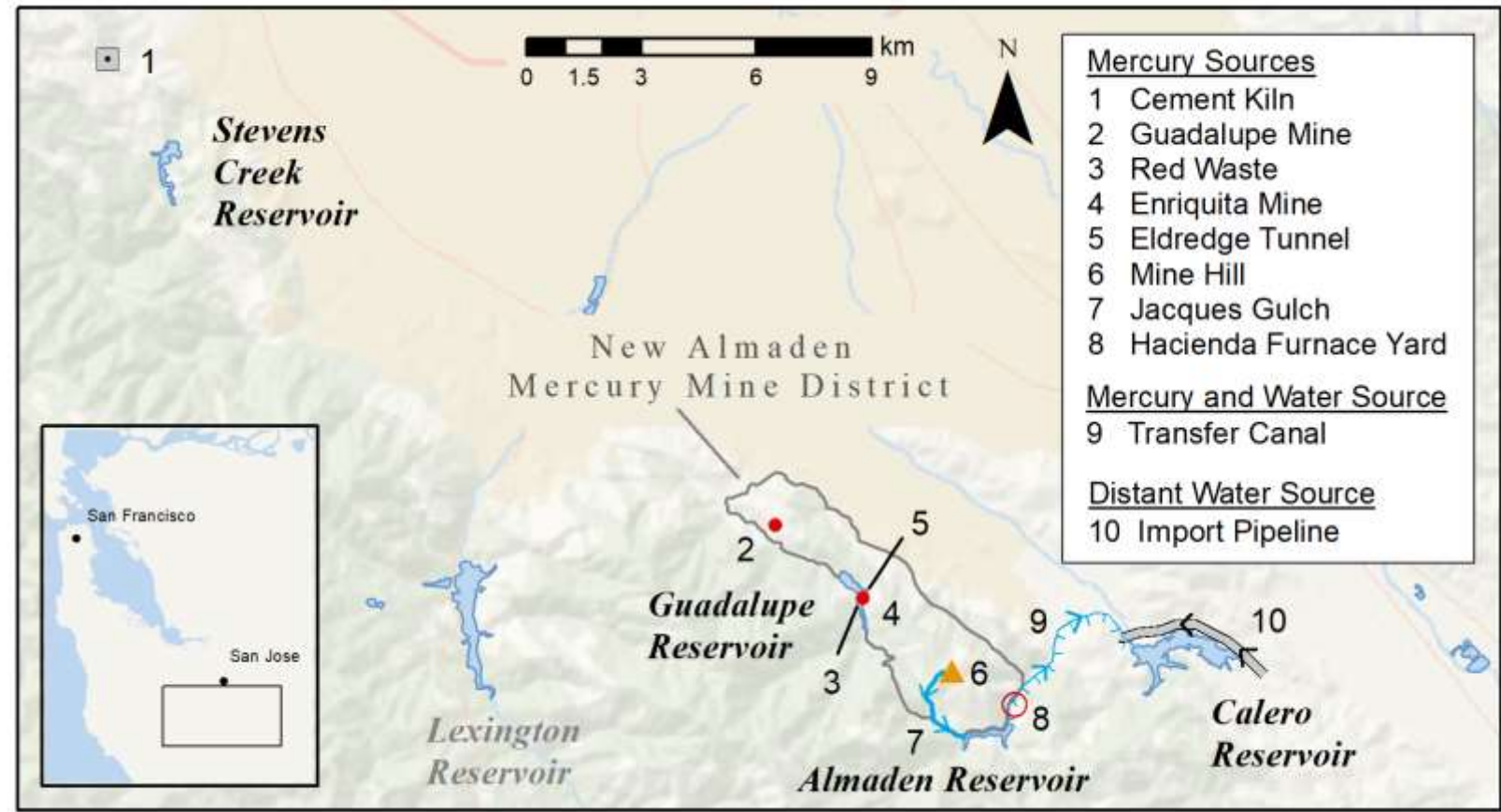
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Associate Water Resources Specialist

# OUTLINE

- Hg in the Guadalupe River Watershed
- Hypolimnetic Oxygenation for Remediation in Reservoirs
- Results from 15-Year Study



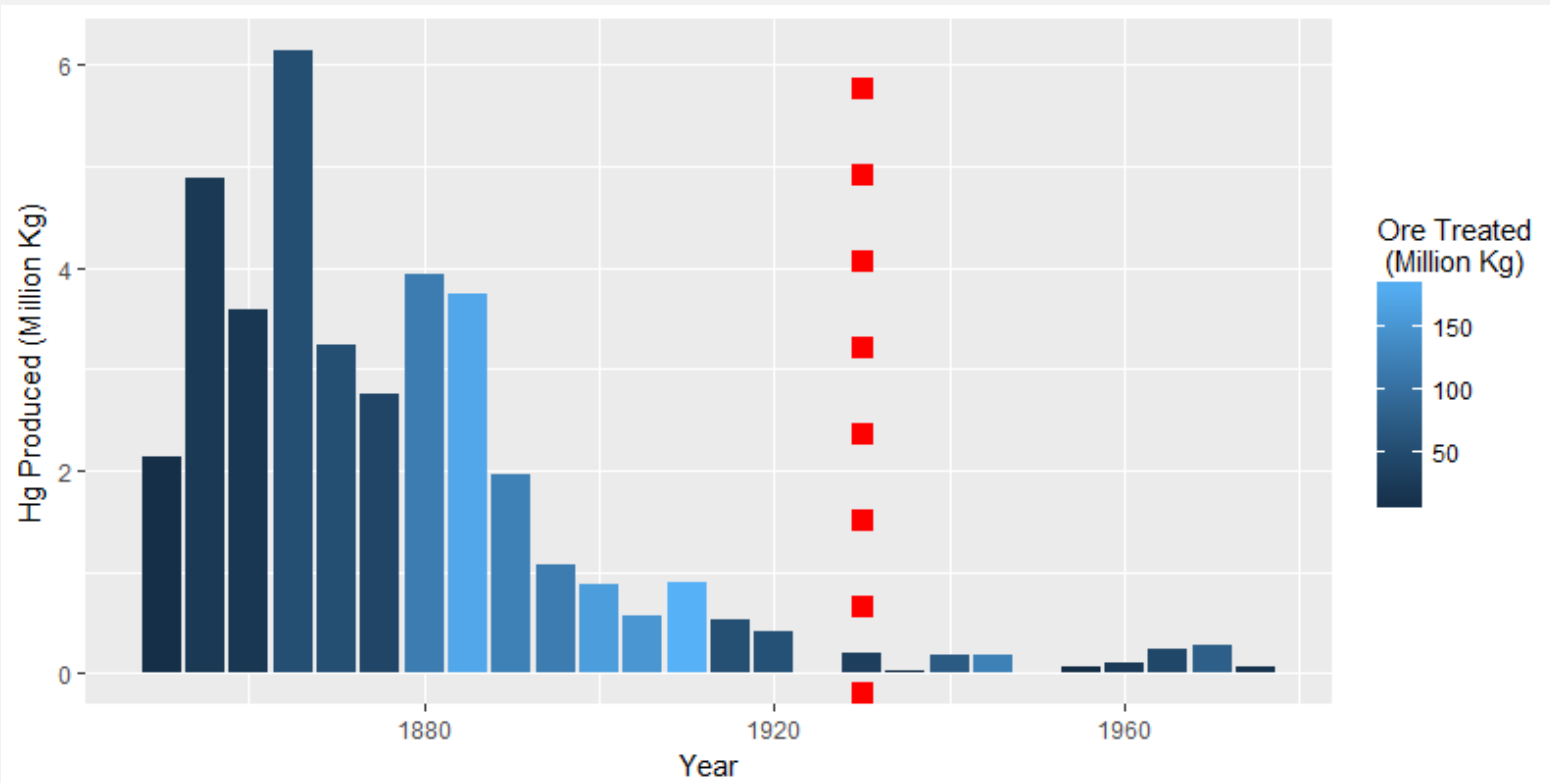
# GUADALUPE RIVER WATERSHED



# NEW ALMADEN MINING DISTRICT (1845-1975)

Avg. Hg (total) Load to SF Bay= **139 kg/year** (McKee, 2017)

Mining Legacy = **83-88% Load**  
(McKee, 2010; McKee, 2017; Tetra Tech, 2008)



Total Production = **39 million kg Hg**





# MINE/ CREEK REMEDIATION

**1975:**  
All mining operation  
ceases

**1977:**  
Almaden  
Quicksilver  
County Park  
Opens

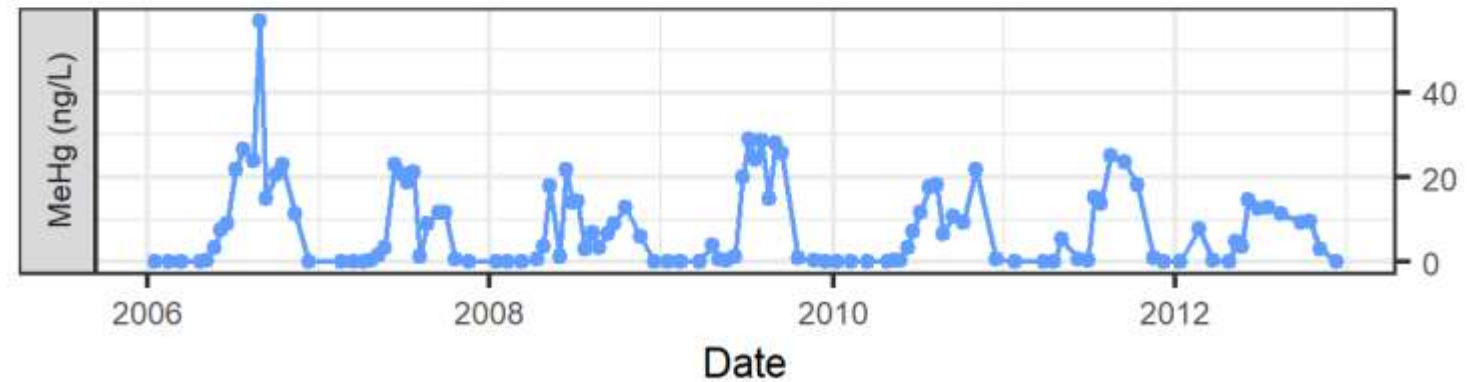
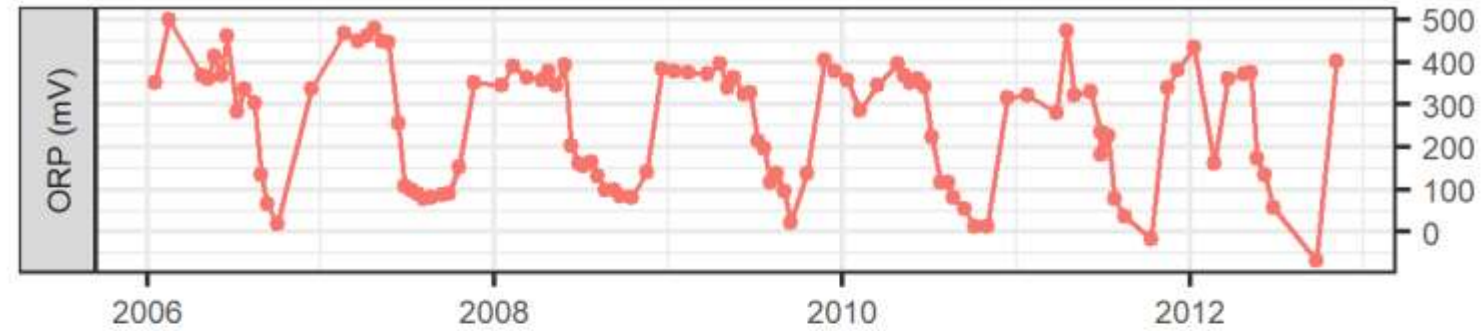
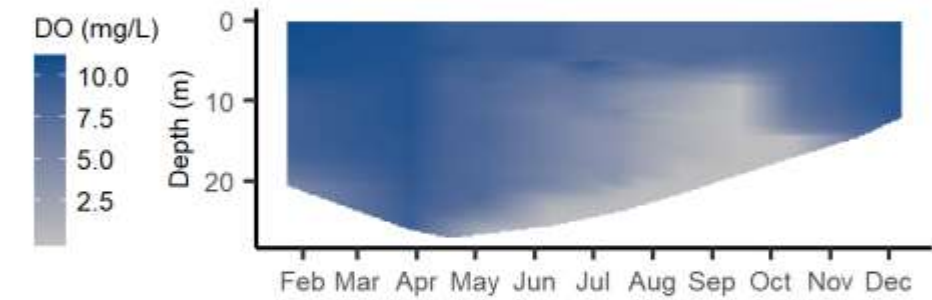
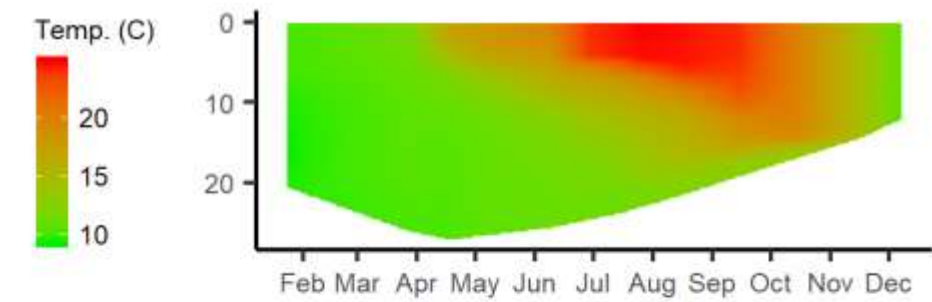
**1981:**  
Hacienda Furnace  
Yard designated  
State Superfund  
Site

**1984:**  
County seals  
mine adits

**1984-2017:**  
CMP &  
Continued  
Remediation



# METHYLMERCURY PRODUCTION



# MERCURY IN FISH

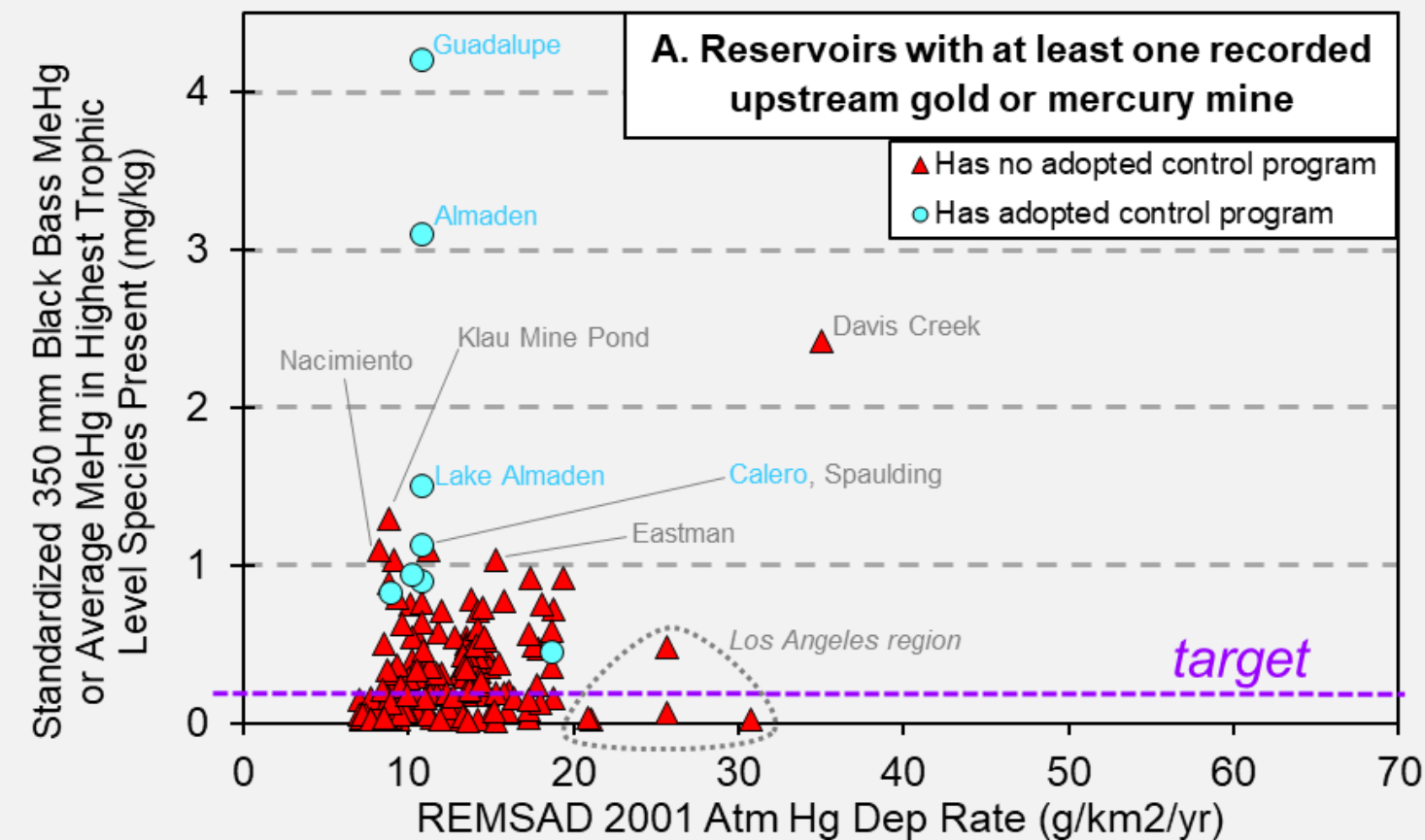


Figure: Statewide Mercury Program for Reservoirs (SWRCB)

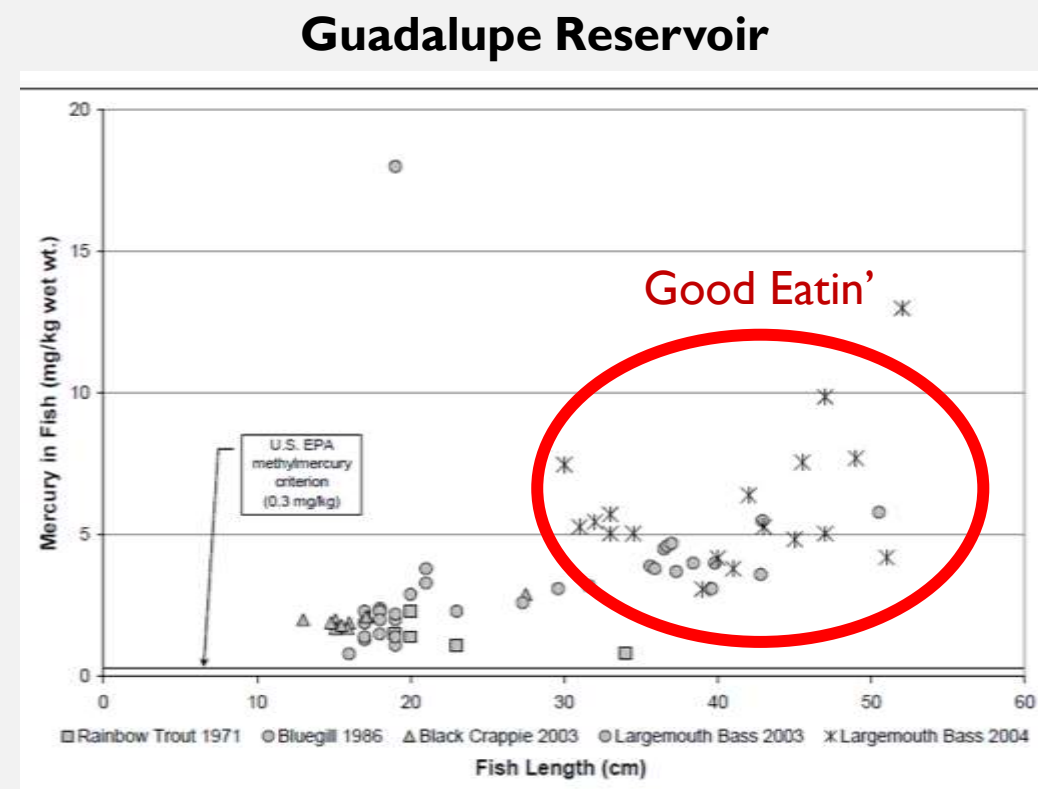


Figure: Guadalupe Hg TMDL Staff Report (SFBRWQCB)



# HEALTH RISK?

58 cm bass! ~8 mg Hg/kg?



One 8 oz. serving

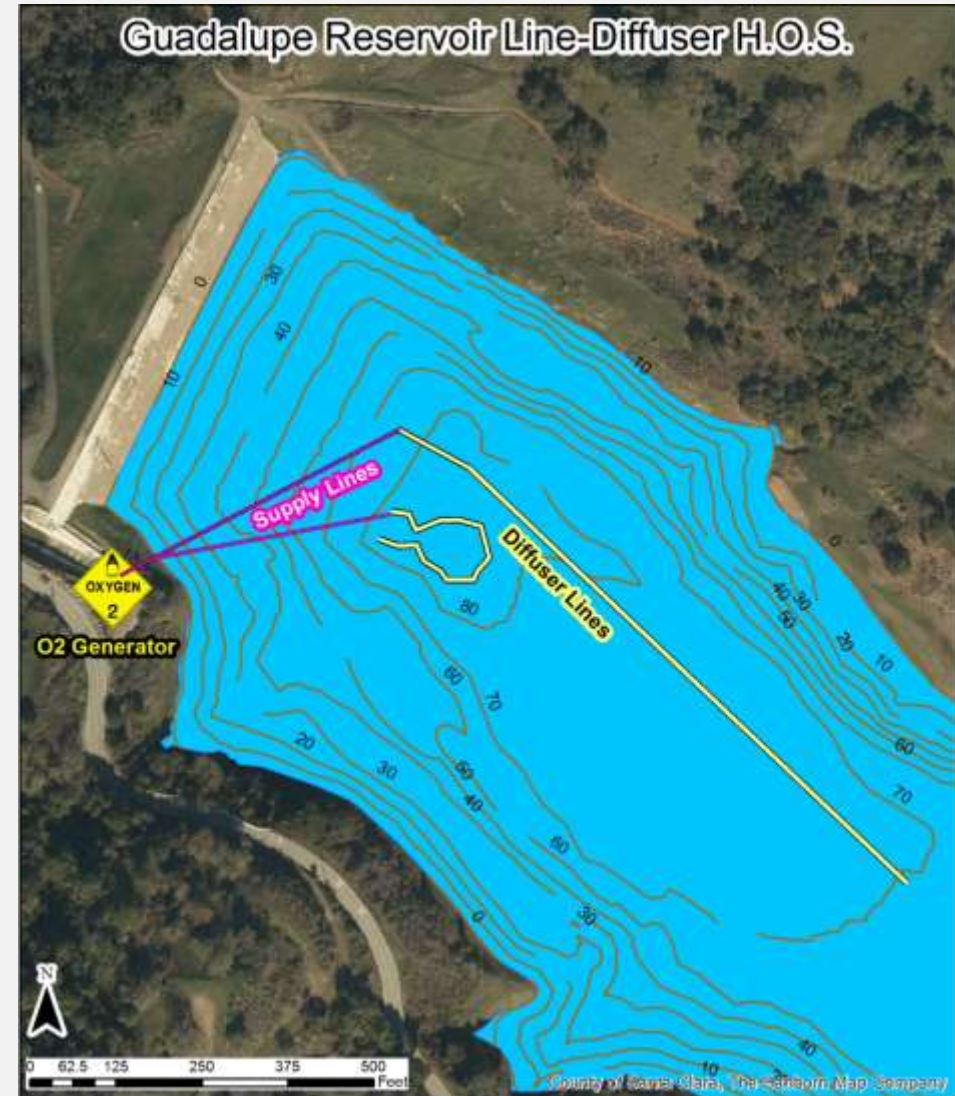
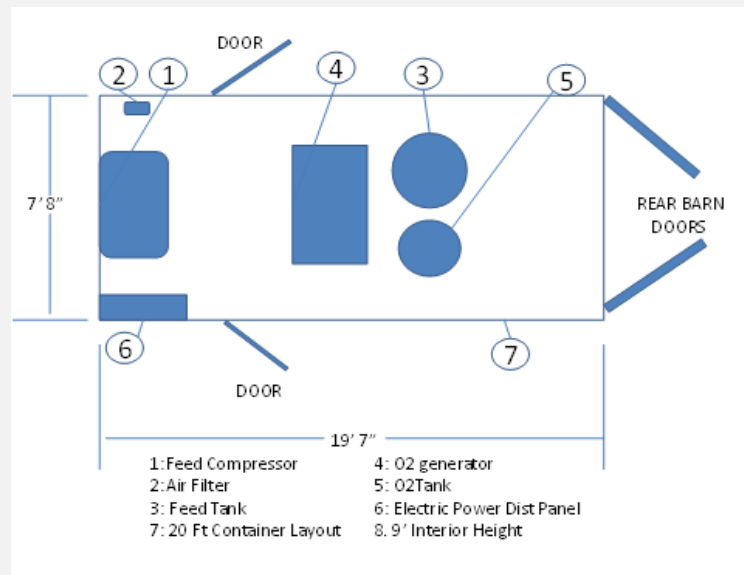


Ingest ~1.8 mg MeHg

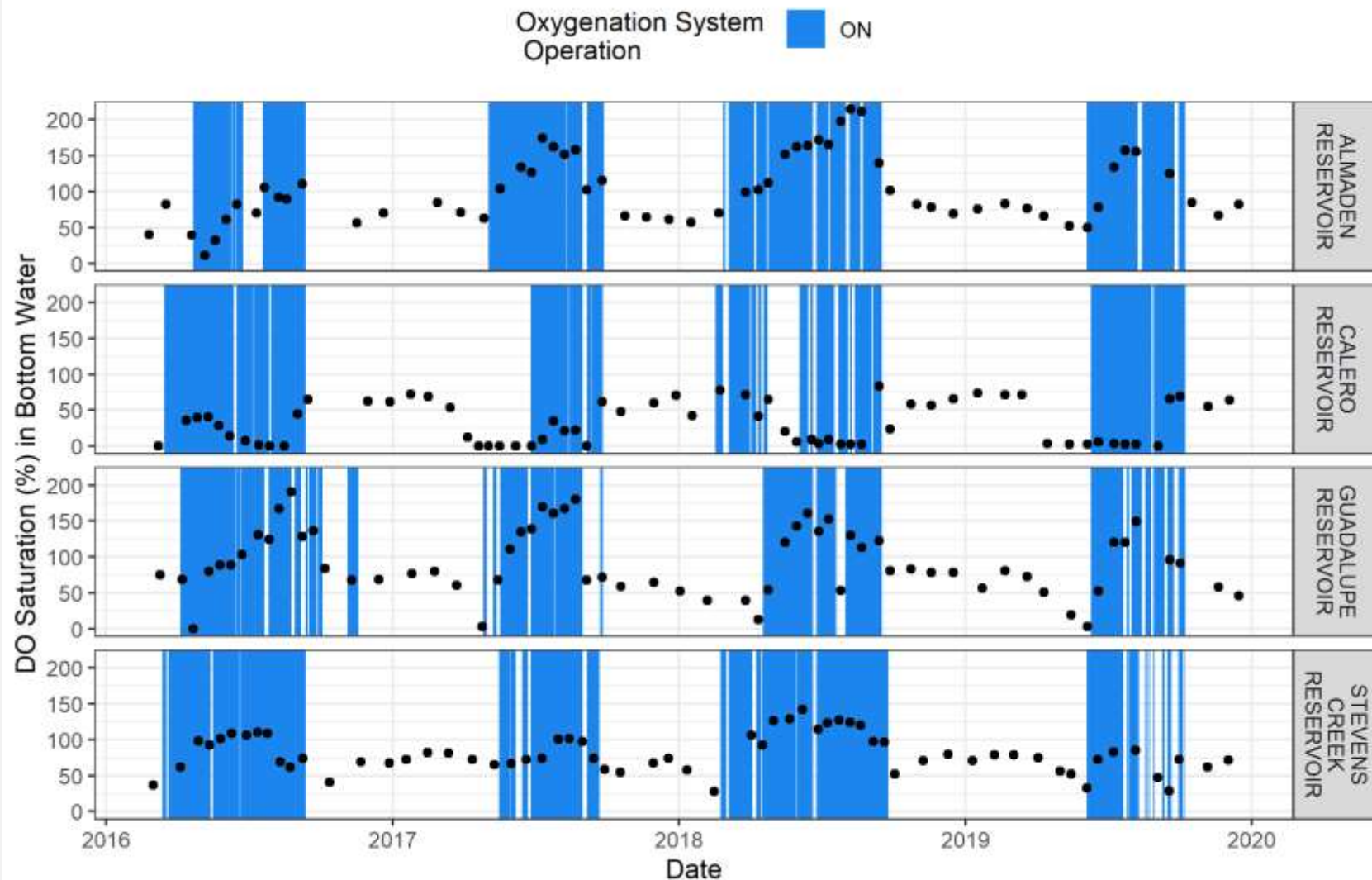




# HYPOLIMNETIC OXYGENATION SYSTEMS

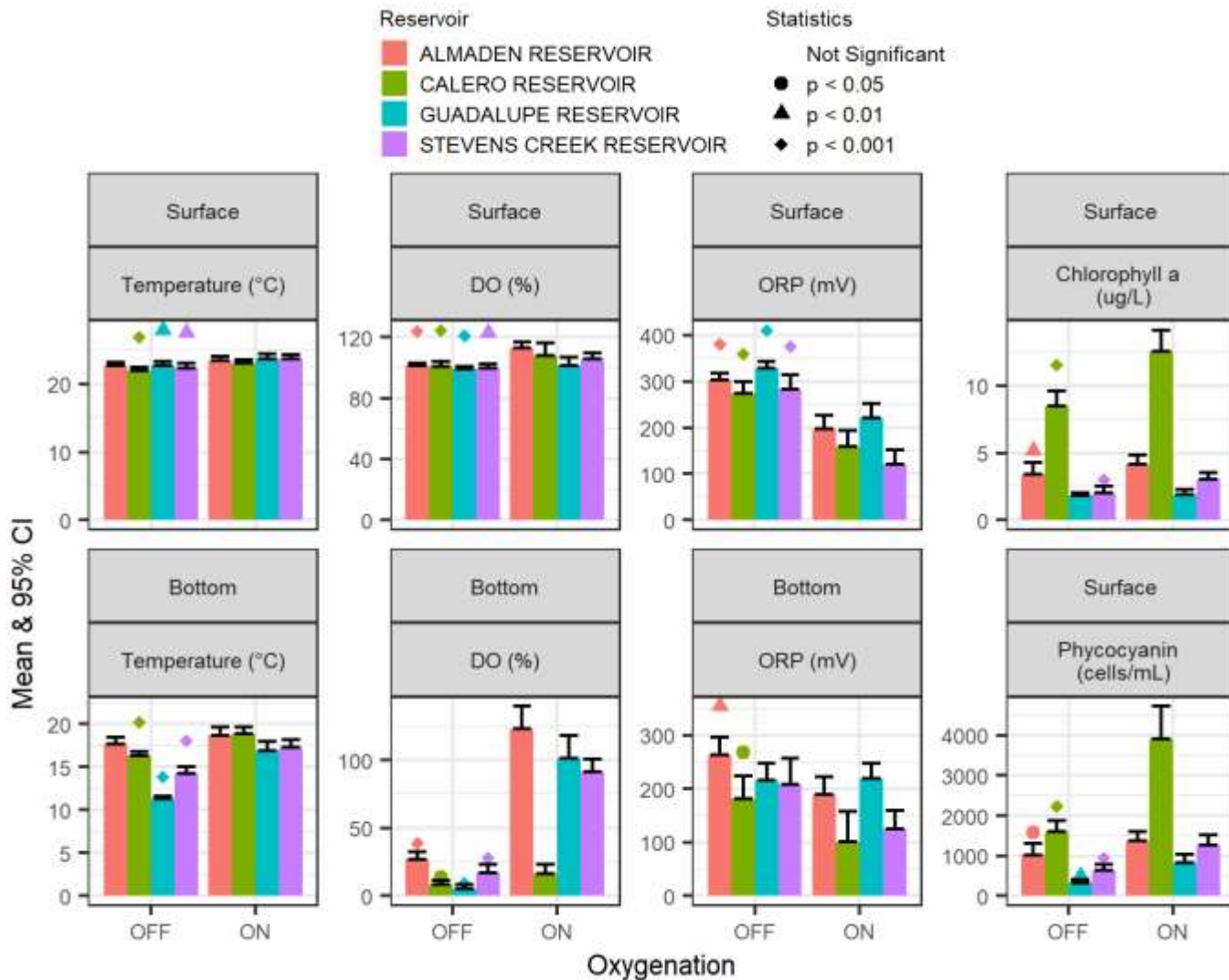


# RESULTS: DISSOLVED OXYGEN



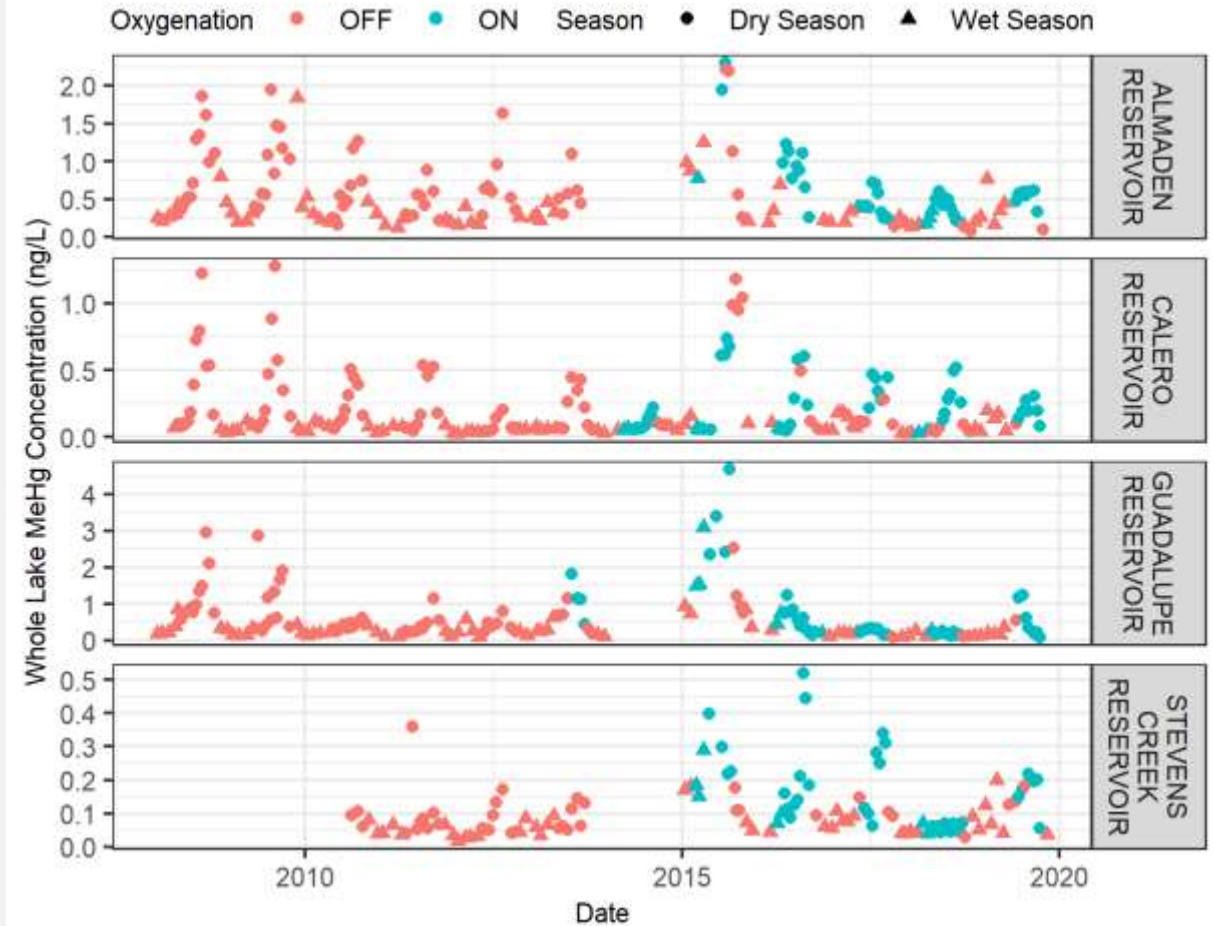
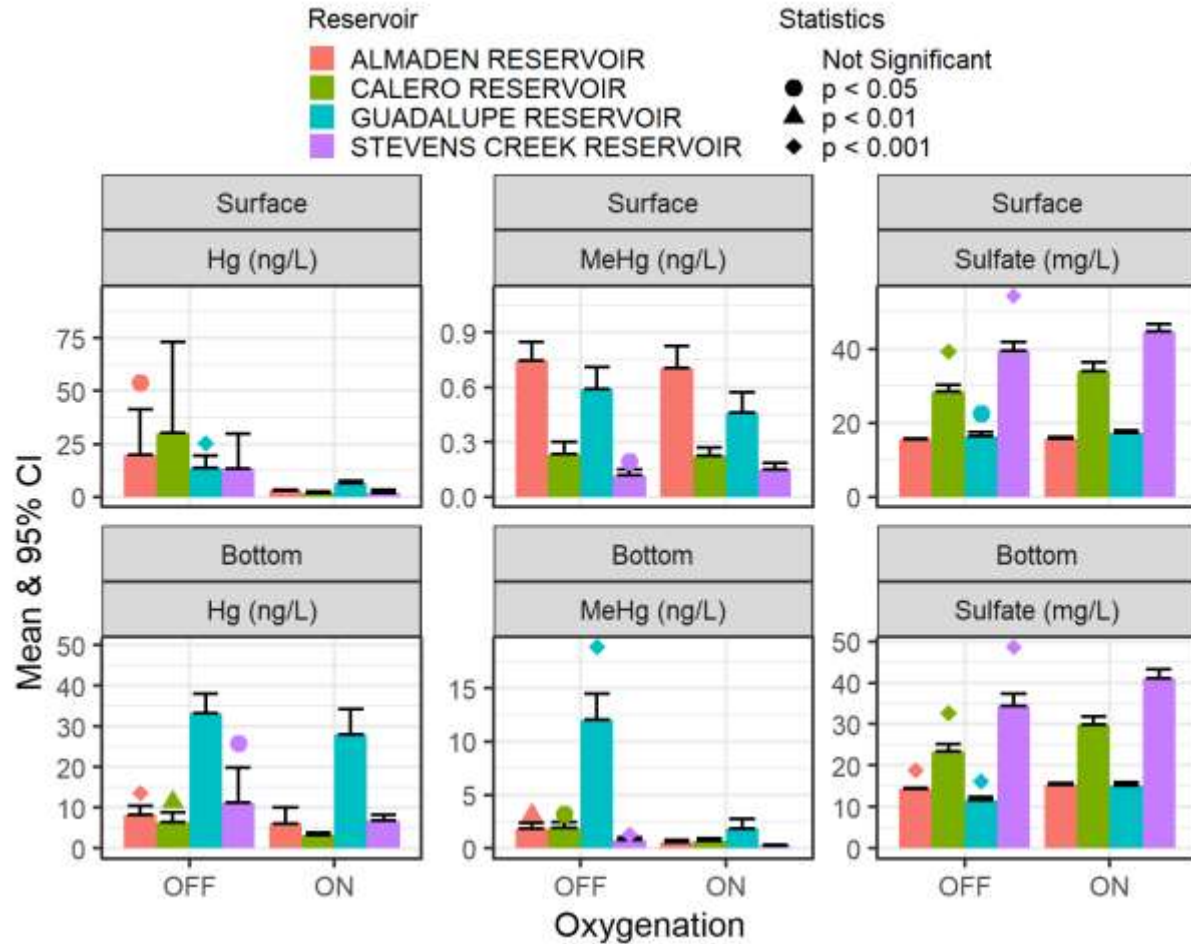


# SELECT RESULTS: WATER QUALITY



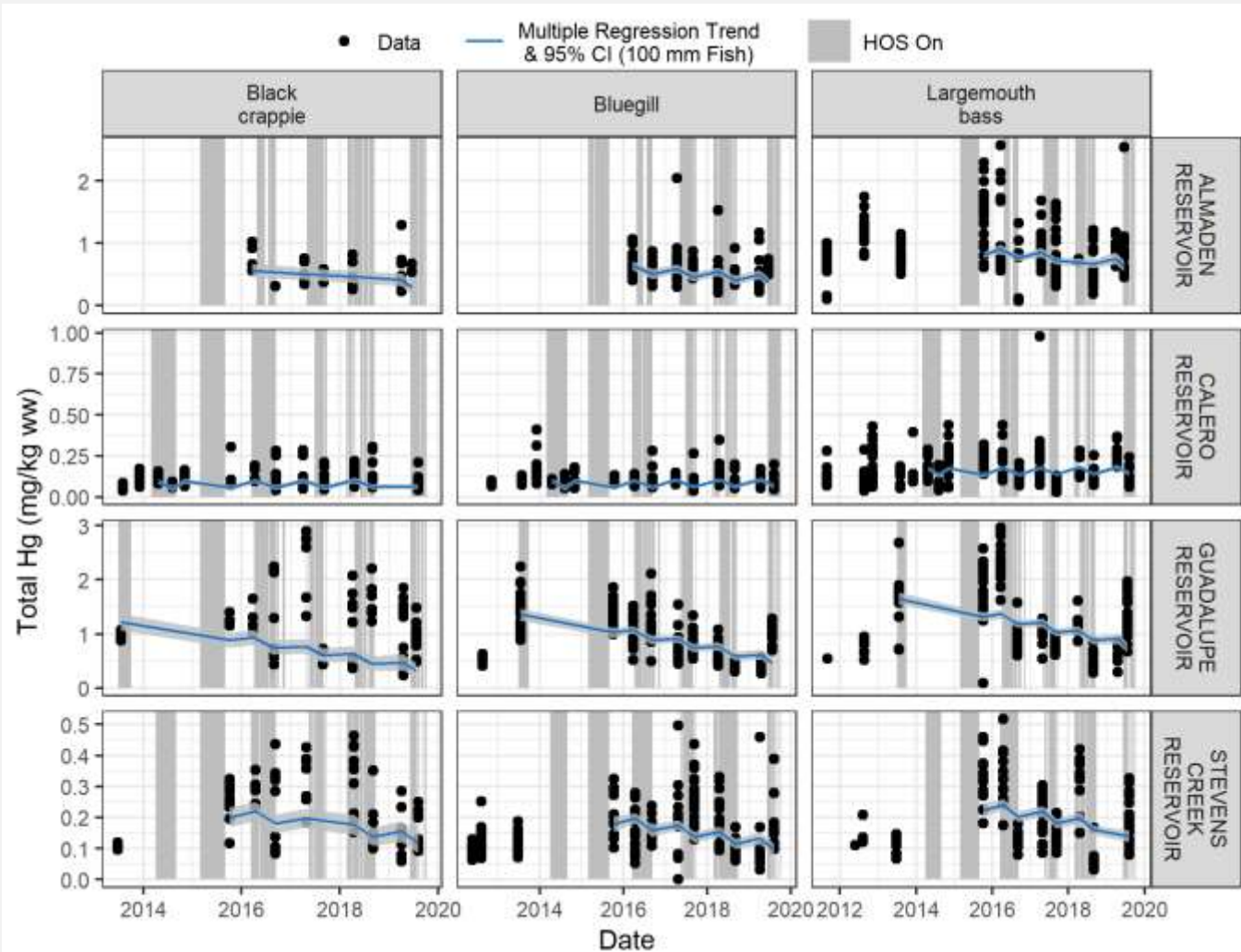
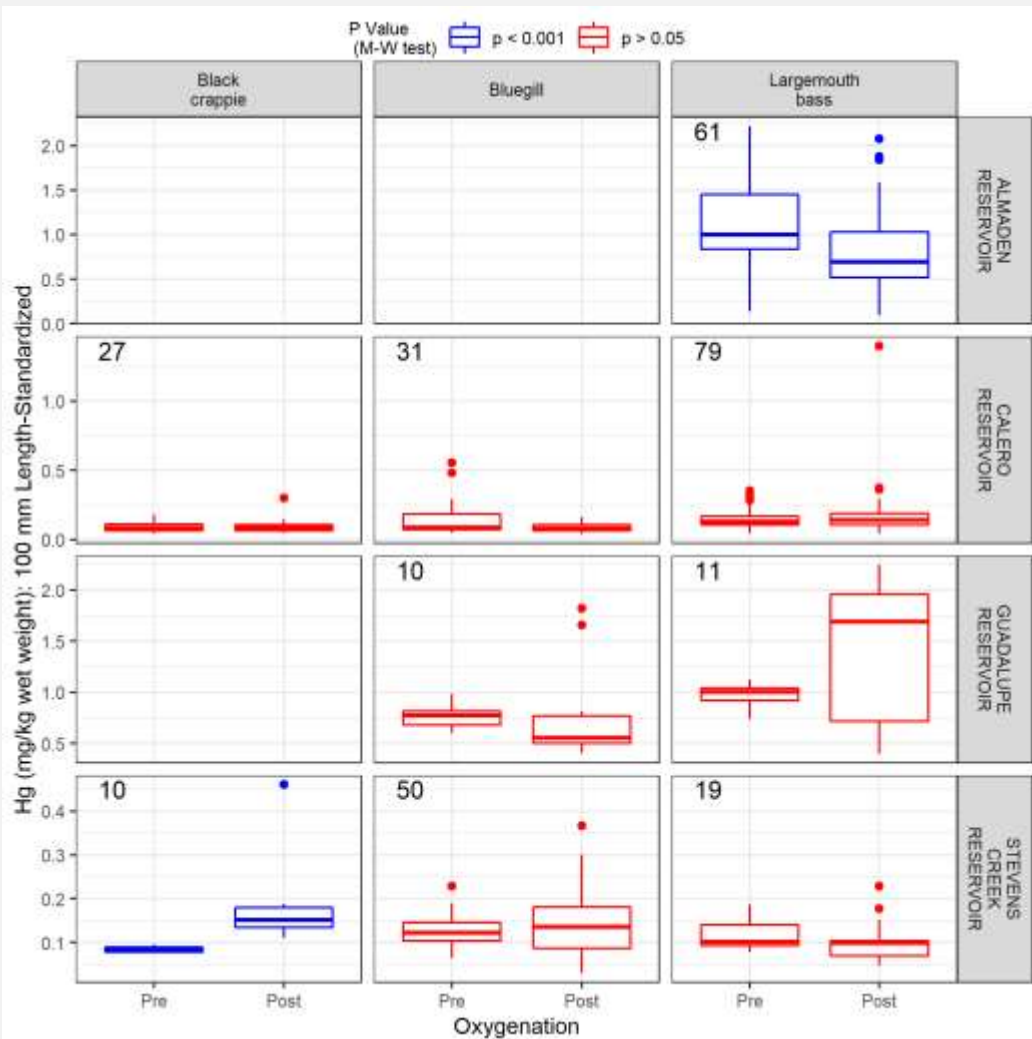
- Increased temperature in all reservoirs except Almaden.
- Increased DO in surface and bottom waters.
- *Decreased* ORP in surface waters.
- Increased primary productivity.

# RESULTS: MERCURY IN WATER





# RESULTS: MERCURY IN FISH



# CONCLUSIONS

1. Declining fish Hg in 2 reservoirs, but why?
  - a. Bloom dilution?
  - b. Food web dynamics?
  - c. Subtle changes in MeHg?
2. HOS mixed profundal compounds into the photic zone.
  - a. Sulfate and nutrient increases.
  - b. Primary productivity increase.
  - c. Temperature and turbidity increases.
3. Other options?
  - a. Speece cone: less exchange from profundal zone.
  - b. Food web or trophic state manipulation?
  - c. Sediment amendments?





# ACKNOWLEDGEMENTS



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**MERCED**



CALIFORNIA LAKE  
MANAGEMENT SOCIETY

NALMS



NORTH  
AMERICAN  
LAKE  
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