SAVANNAH RIVER SITE'S A-01 CONSTRUCTED WETLAND SYSTEM: A MODEL FOR SUSTAINABLE AQUATIC RISK MITIGATION

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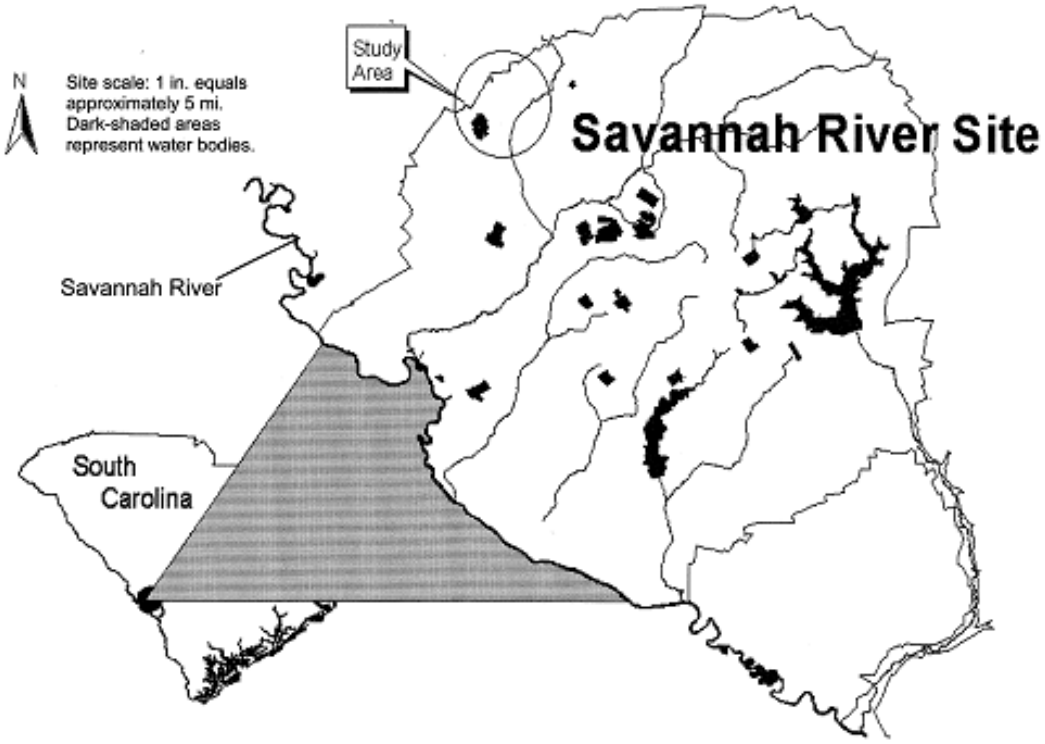
A-01 Outfall

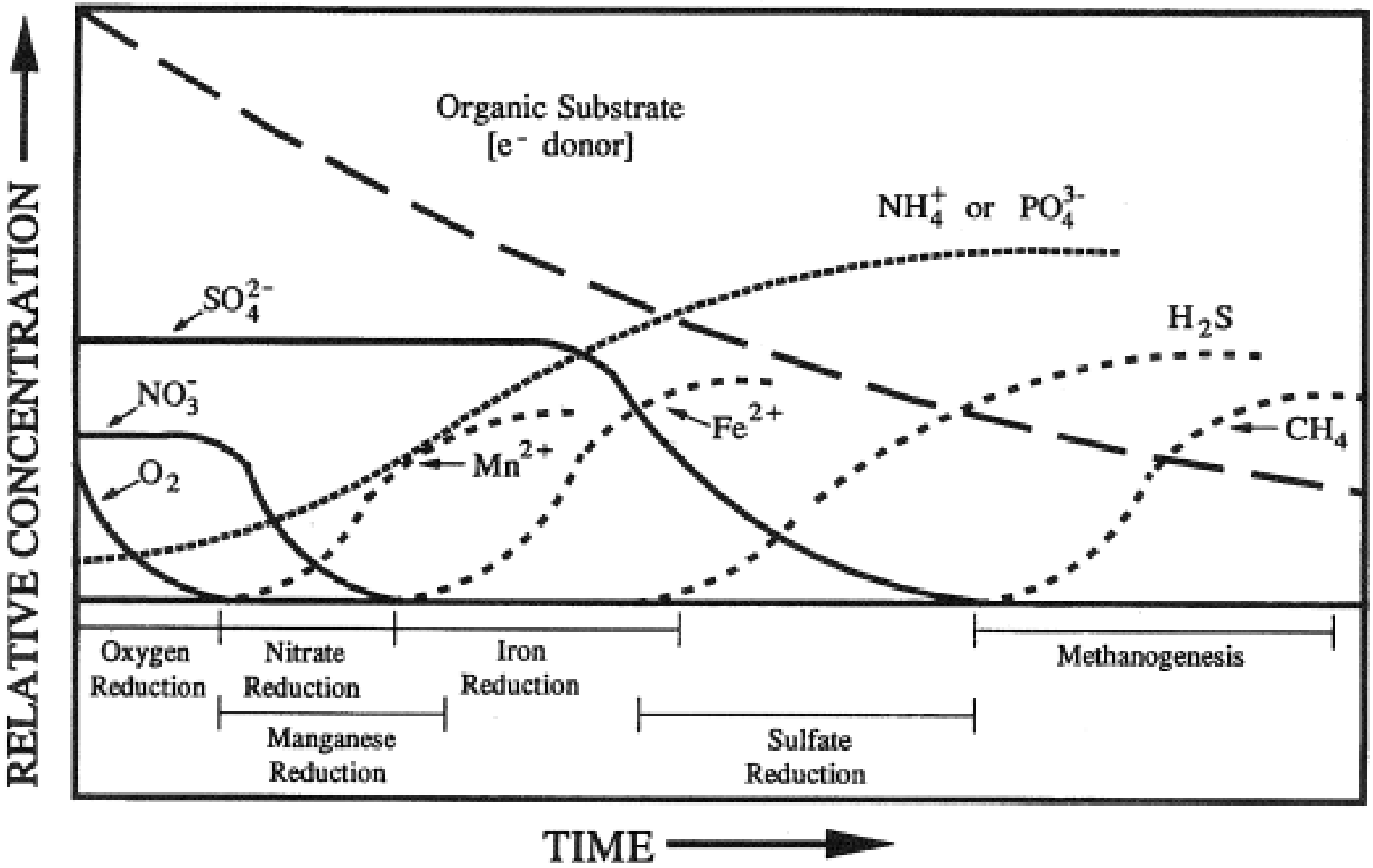


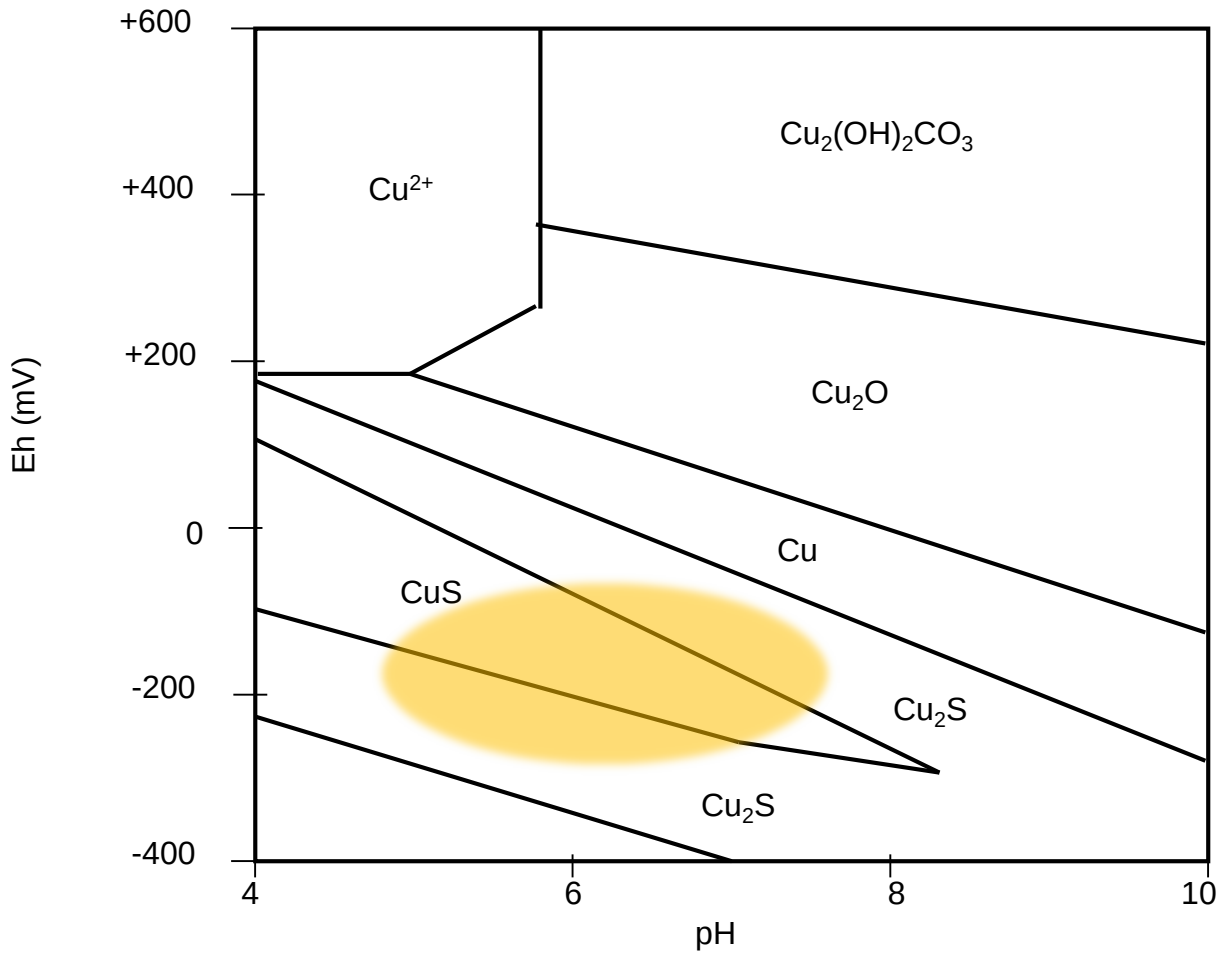
- Avg flow 0.97 mgd
- 250,000 to 2,600,000 gpd
- Copper toxicity
- NPDES limit 22 µg/L
- 190-ac watershed

Risk Mitigation

- Decrease exposure concentration, duration, or frequency
- Change form

Mitsch and Gosselink, *Wetlands* (1993)





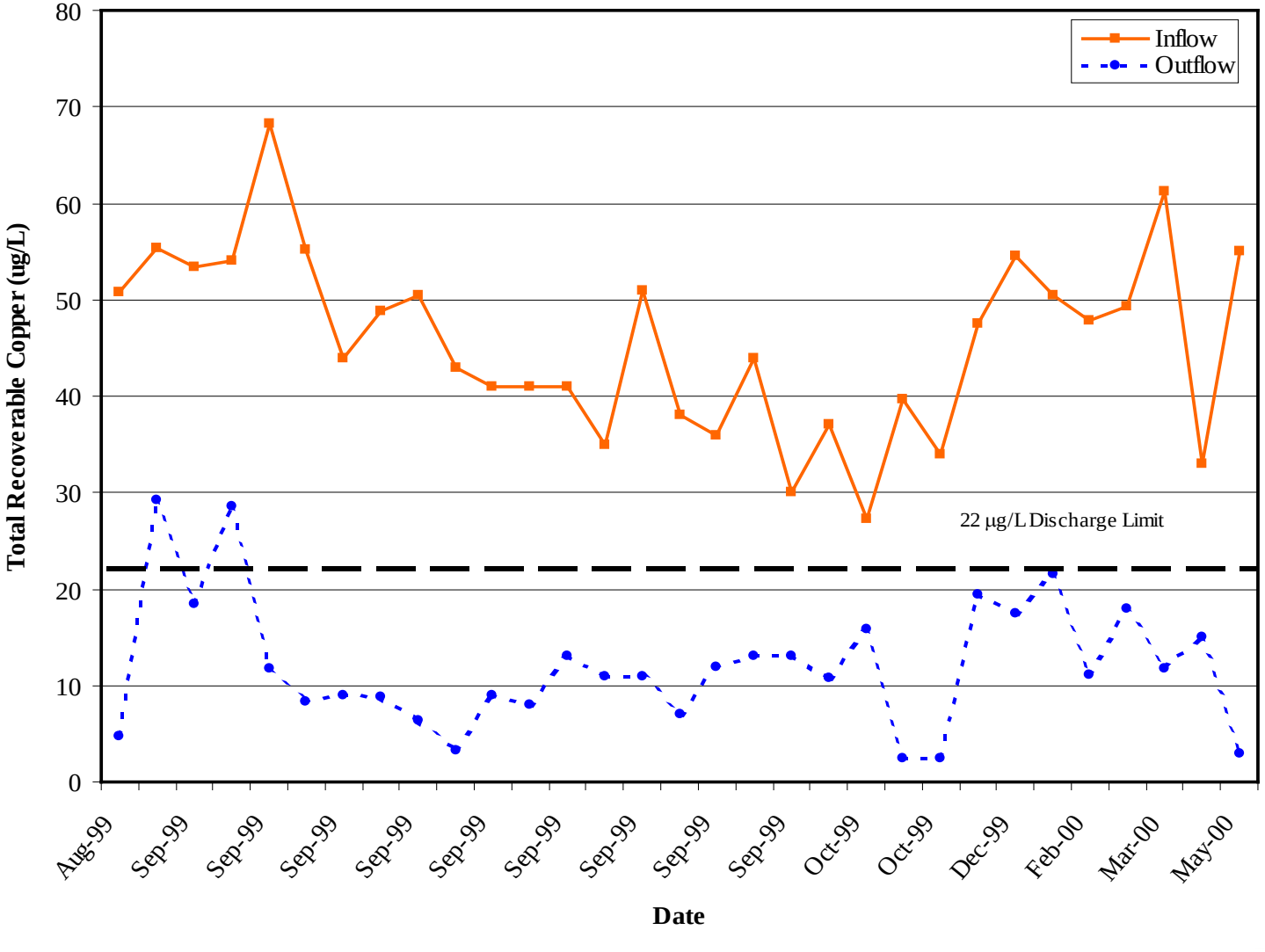
Eh-pH model for Cu-O-H-S system. Modified from Brookins (1988).

Research objectives

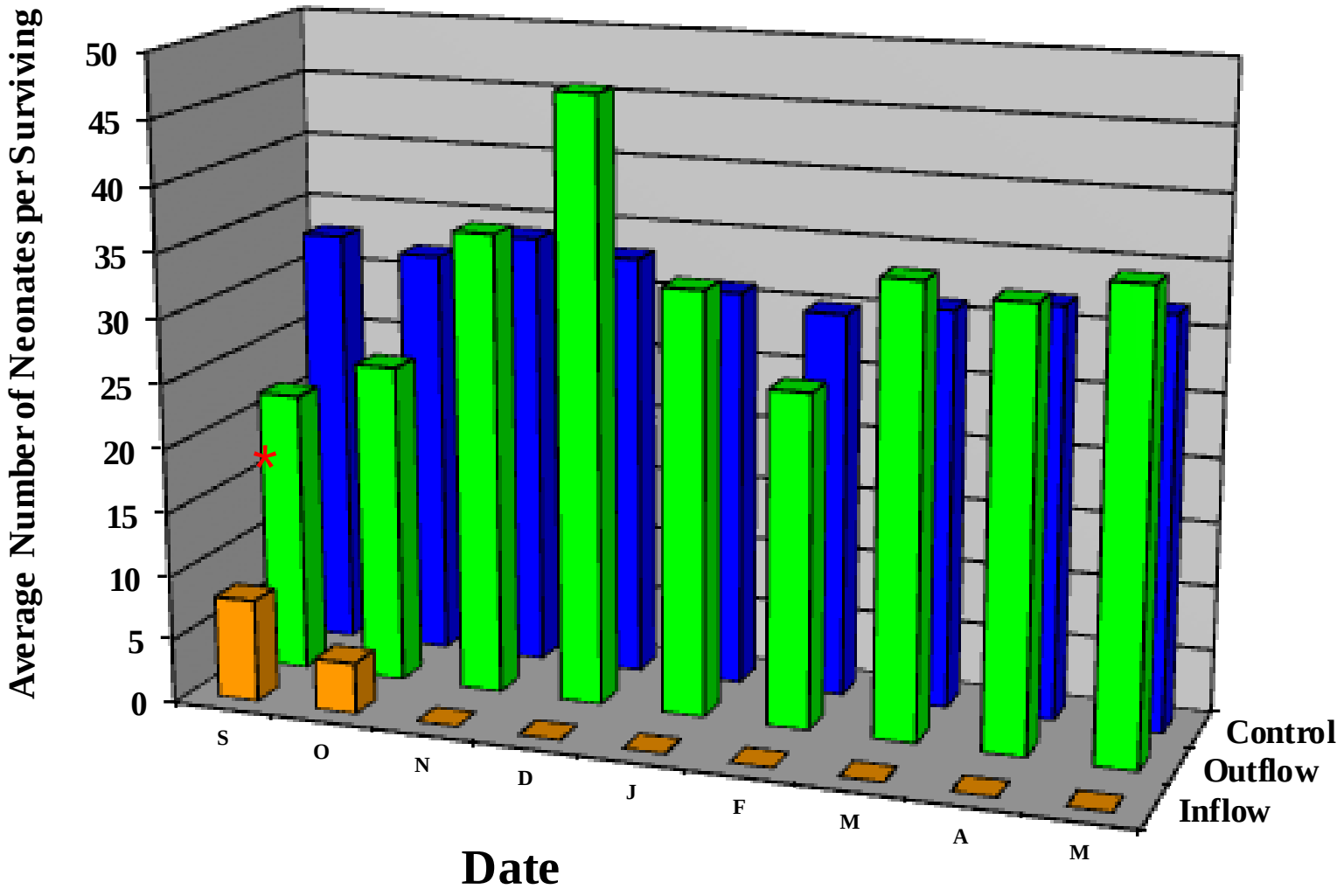
- Develop a conceptual model of a constructed wetland system based on copper biogeochemistry.

- Develop and evaluate a physical model of a constructed wetland system for mitigating ecological risks from copper.

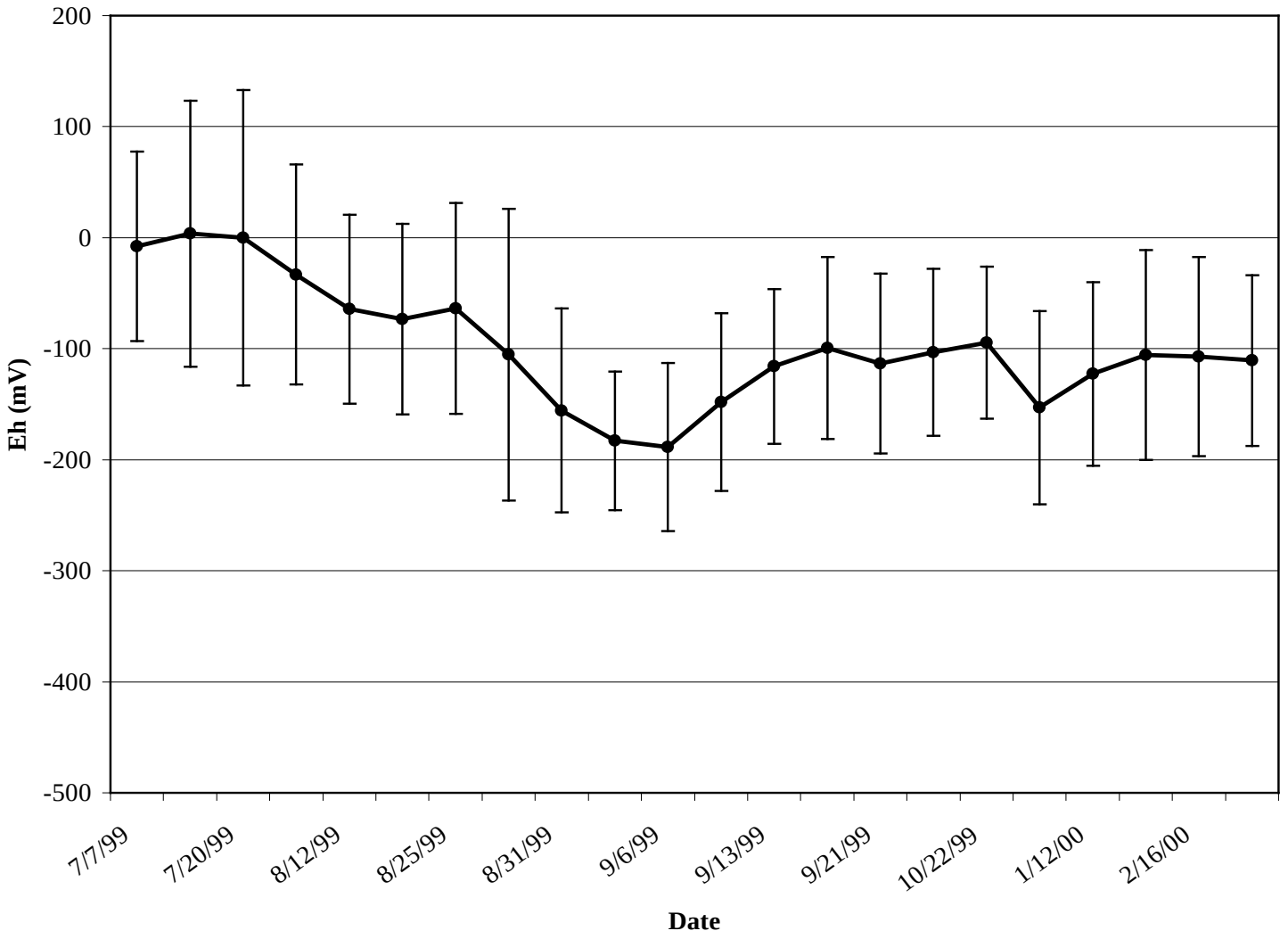
Total (acid soluble) copper in wetland inflow and outflow



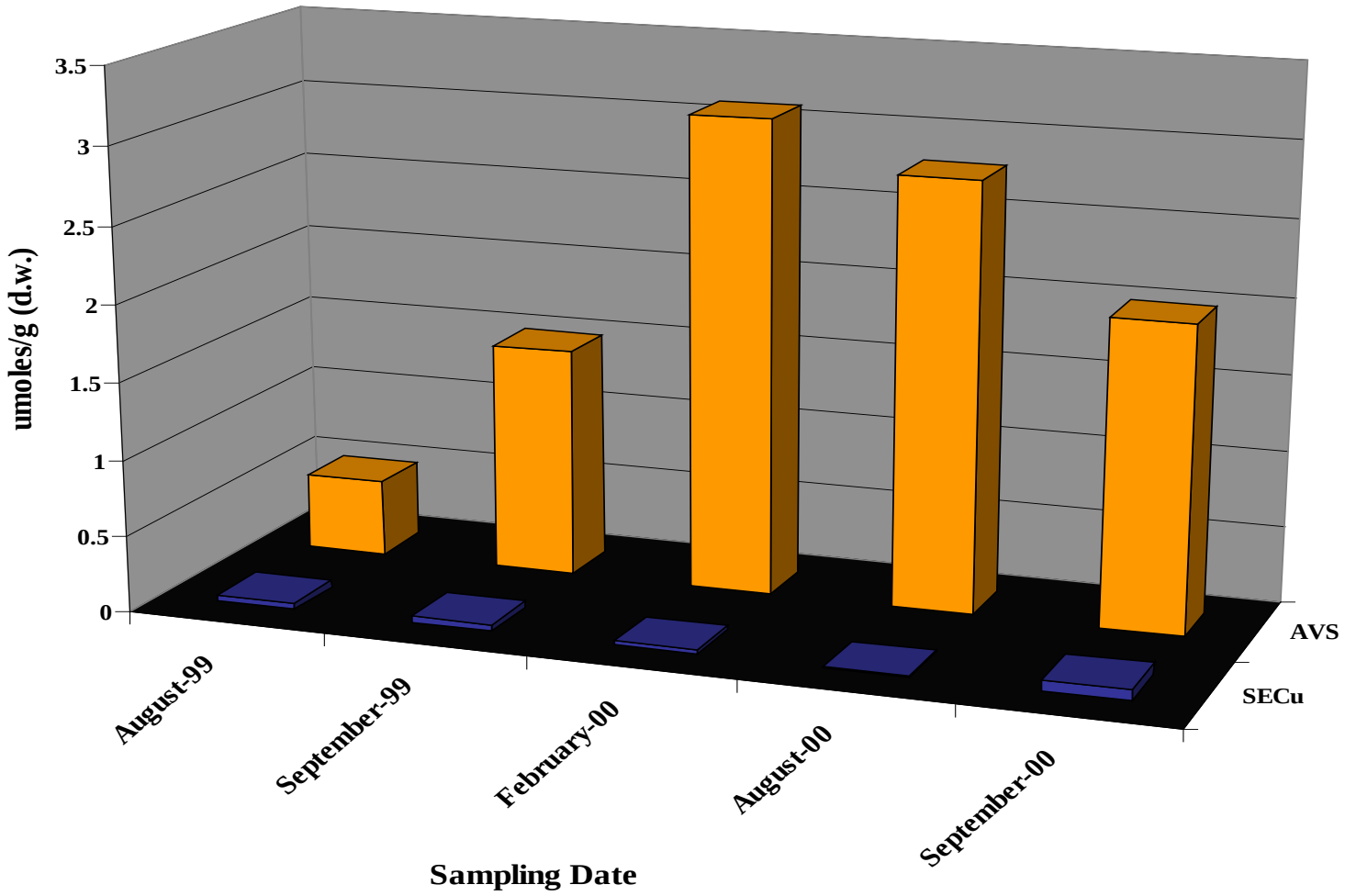
Ceriodaphnia dubia reproduction in wetland inflow and outflow



Hydrosoil redox potential

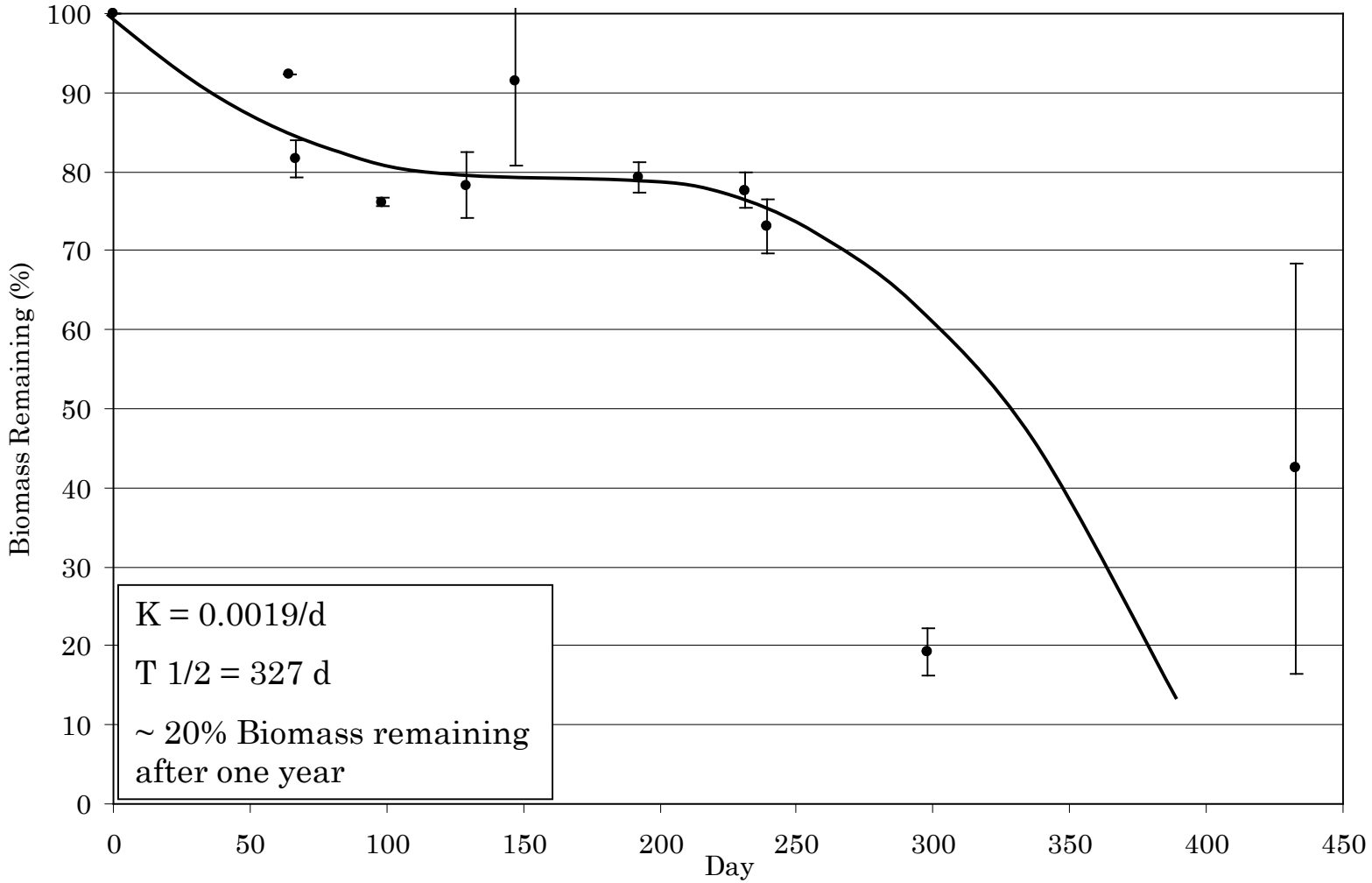


Acid volatile sulfides



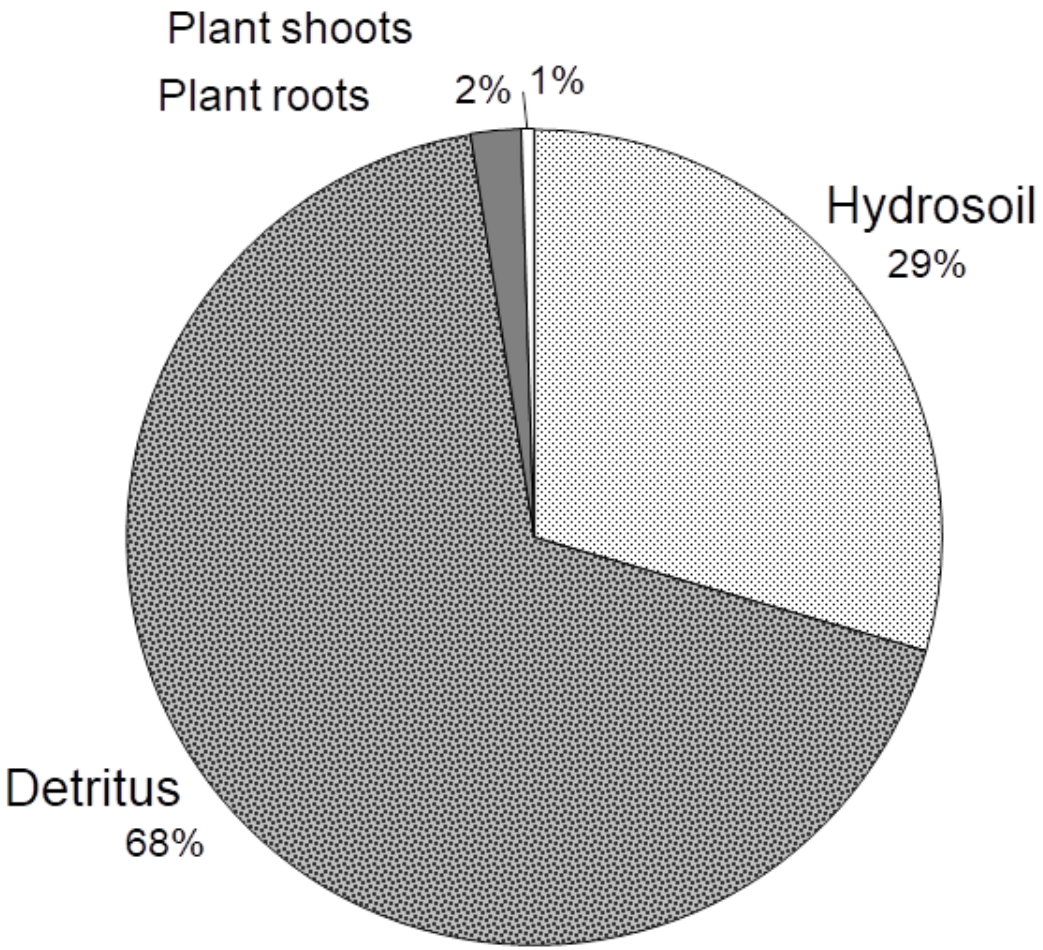
Acid volatile sulfide concentrations versus simultaneously extractable copper in a model constructed wetland system.

S. californicus decomposition



Decomposition of *S. californicus* detritus in a model constructed wetland system receiving copper-contaminated water, October 1999 through March 2001.

Distribution of copper in wetland system



Physical Model Results
(applied to full-scale wetland design)

- Total copper concentrations decreased below target discharge level in outflow
- No observed toxicity in outflow
- 73% total copper removed from aqueous phase
- Copper half-life in water was ~24 h

Physical Model Results
(applied to full-scale wetland design)

- Hydrosoil supported sulfate reducing bacteria
- Bulrush detritus will accrete over time to provide organic matter for dissimilatory sulfate reduction and ligands
- Ecological risks to the receiving waters mitigated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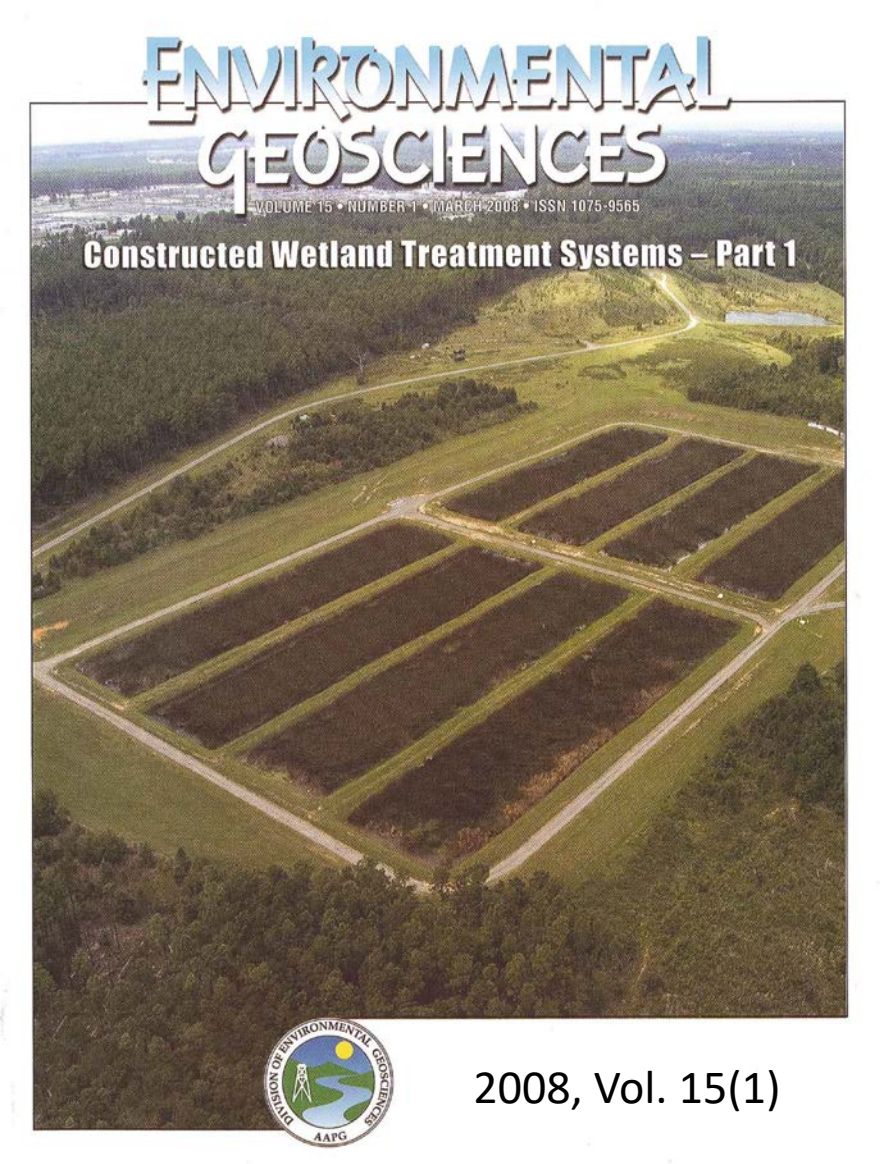

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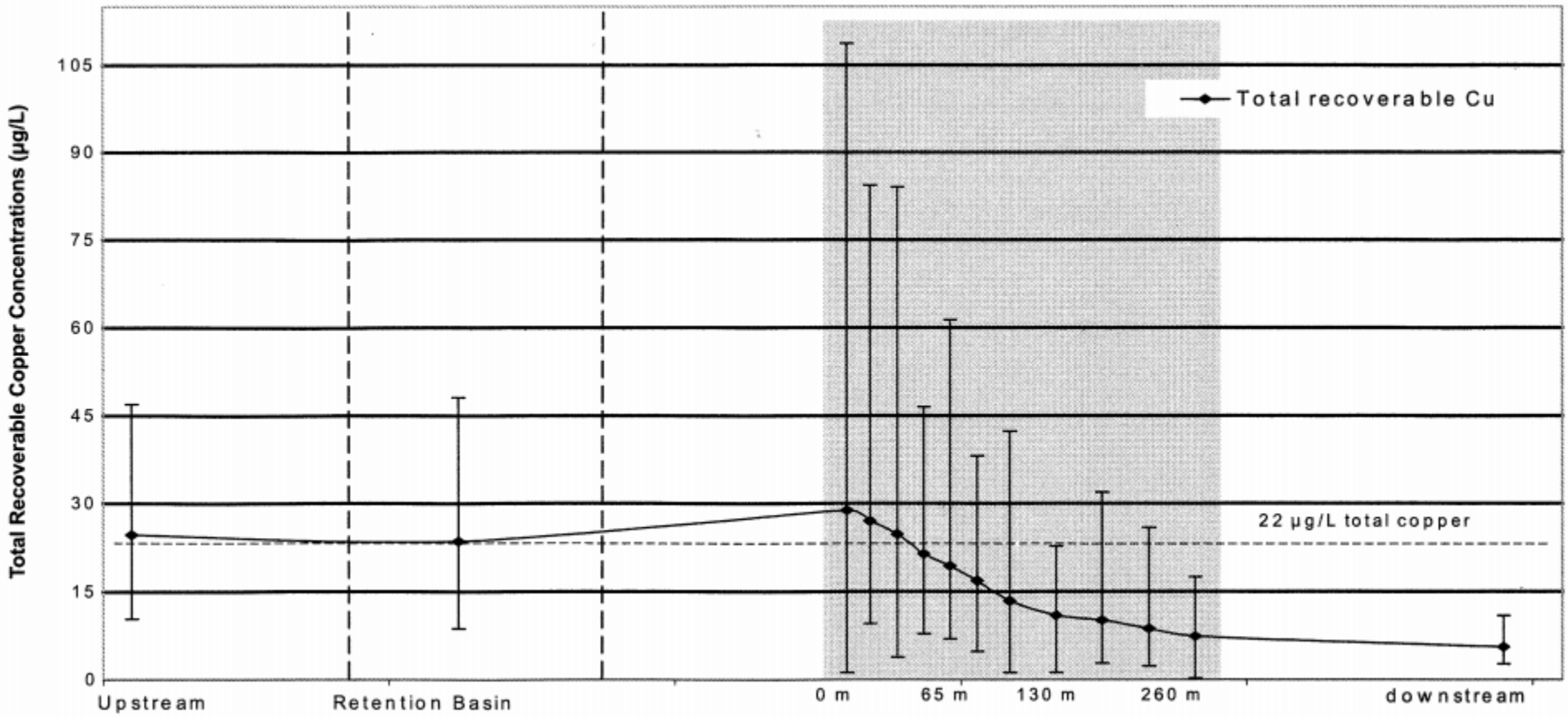
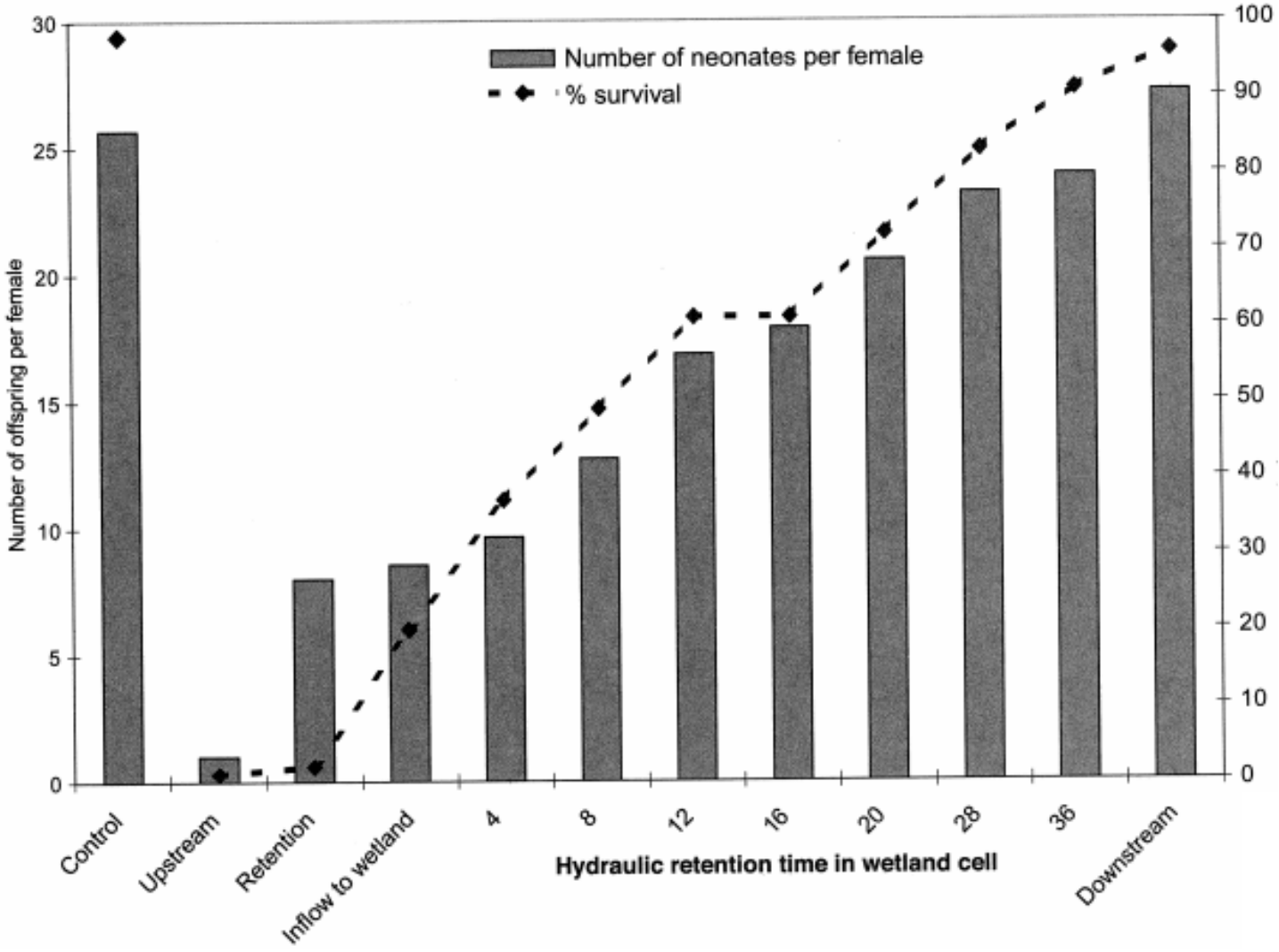
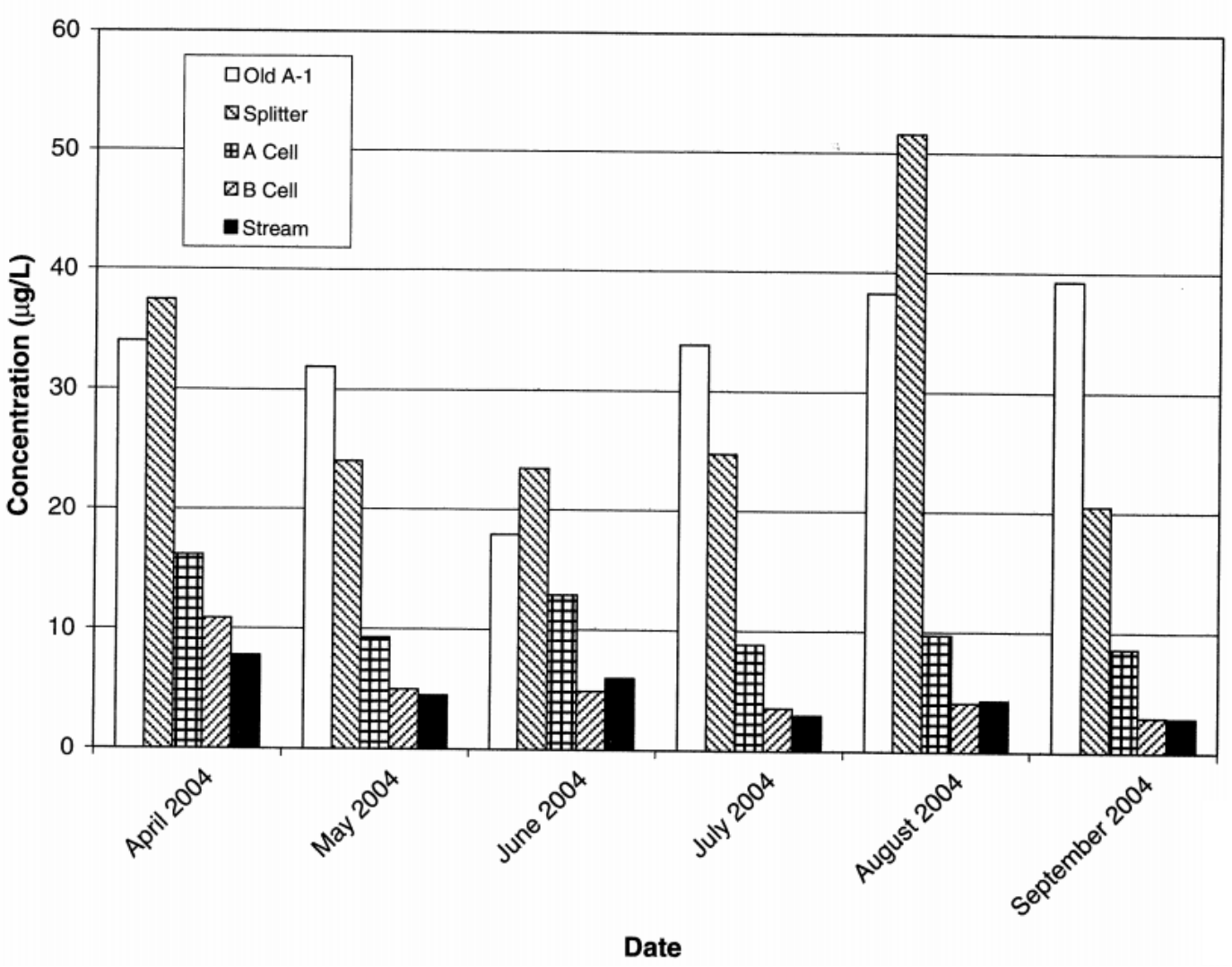
Aqueous copper removal, 2001-2002 (Murray-Gulde *et al*. 2008)



C. dubia survival and reproduction, 2001-2002 (Murray-Gulde *et al*. 2008)



Aqueous copper removal, 2004 (Nelson and Gladden, 2008)



Conclusions

- The A-01 constructed wetland system has been operational and NPDES compliant since 2001.
- The A-01 constructed wetland system received recognition from the U.S. Department of Energy and U.S. Environmental Protection Agency Region 4 as a model application of sustainable technology, having saved SRS over $60 million over the life of the system.