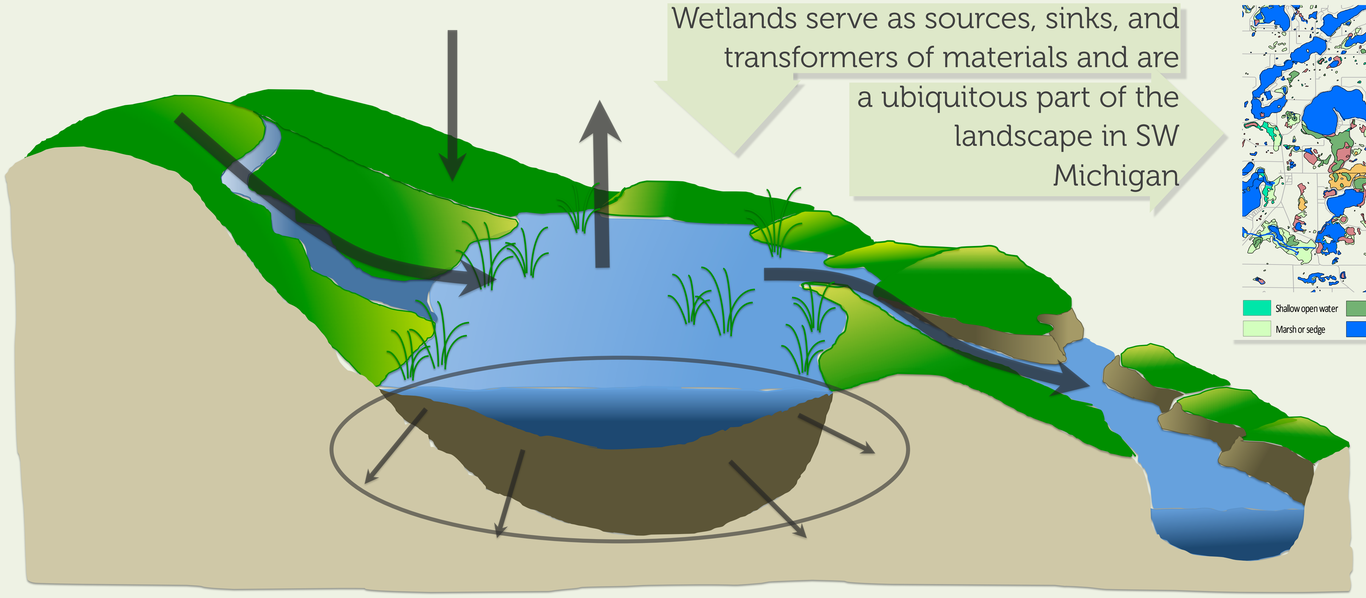
Do hydrologic fluctuations regulate biogeochemical fluxes to surface waters in a riparian wetland?

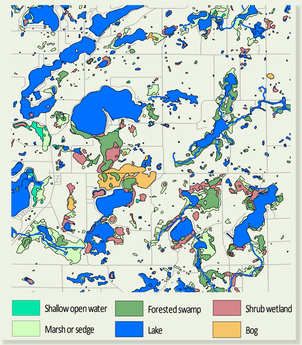
Drying and wetting: a whole ecosystem manipulation

Dustin W. Kincaid & Stephen K. Hamilton | Department of Zoology & Kellogg Biological Station, Michigan State University

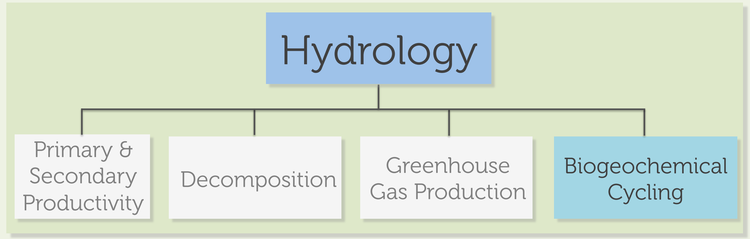
Wetlands influence the biogeochemistry of surface waters in a watershed



Wetlands serve as sources, sinks, and transformers of materials and are a ubiquitous part of the landscape in SW Michigan



Hydrology regulates the function of wetland ecosystems



But local and global hydrology is being altered

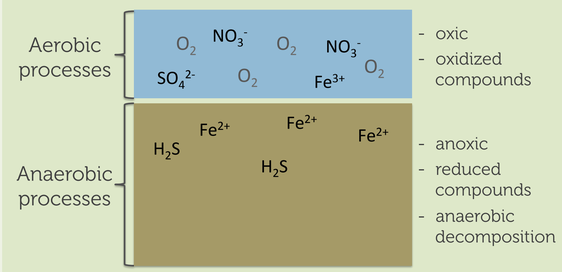
Changes in precipitation regimes due to climate change

Dam construction and removal

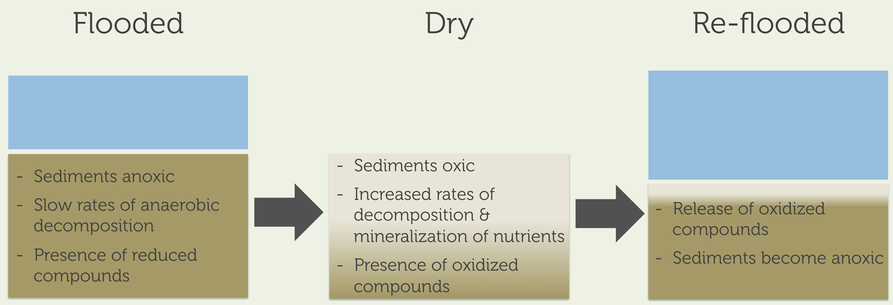
Restoring floodplain-river connectivity

Hydrologic fluctuations alter redox conditions and influence biogeochemical fluxes in wetland sediments

Typical water-sediment interface



Drying & re-wetting sediments



Acknowledgements
Funding: KBS-LTER & KBS Summer Research Fellowship
Lab and field assistance: David Weed, Bonnie McGill, Suzanne Sippel, & Lucas Hamilton

MICHIGAN STATE UNIVERSITY

KBS LTER Kellogg Biological Station Long-term Ecological Research

Hydrologic manipulation of a riparian wetland

SITE

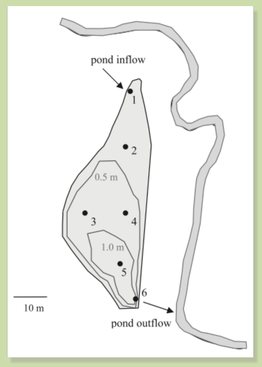
Kellogg Forest Pond, Kellogg Forest, Augusta, MI

Typical of small impoundments on our landscape

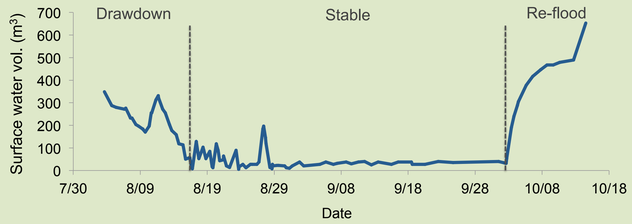
Hydrology: artificial through-flow wetland adjacent to Augusta Creek; mean depth ~0.5m

Sediments: fine organic detritus enters pond from Augusta Creek, which has led to an accumulation of a thick layer of loose, flocculent sediment and a mucky delta at the inflow which covers ~1/3 of the pond area

Figure 1. Kellogg Forest Pond prior to drawdown a) surface water in pond; b) partially exposed mucky delta; c) sampling the loose, flocculent sediment .



HYDROLOGIC MANIPULATION & SAMPLING



Figures 2 (left) & 3 (right). Surface water volume in Kellogg Forest Pond for the duration of the experiment. 3a) We sampled porewater in the sediment one week prior to draining using porewater equilibrators; 3b) during the hydrologic maniupulation we sampled surface water chemistry at the outflow/pump region.

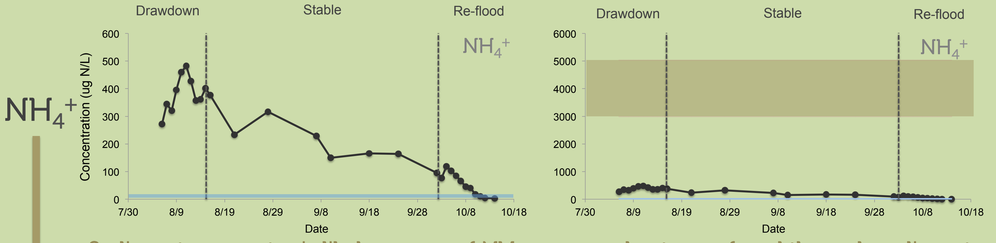
RESULTS: SURFACE WATER CHEMISTRY

Key to figures below

Range of stream & groundwater concentrations (95% conf. int.)

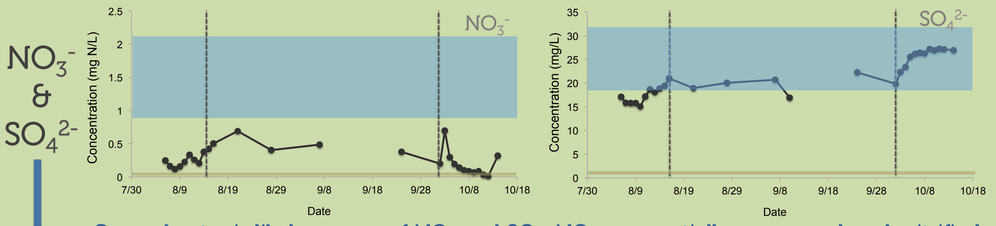
Range of porewater concentrations (95% conf. int.)

NH_4^+



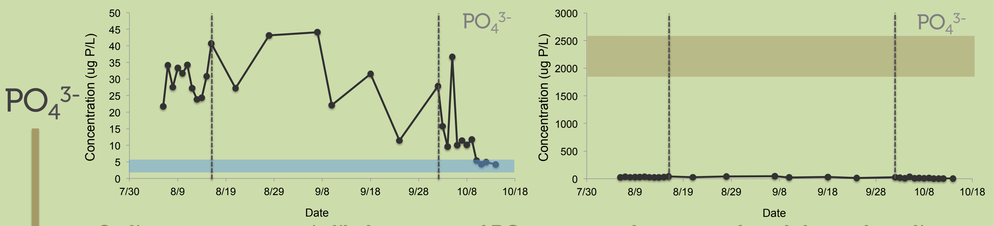
Sediment porewater is likely source of NH_4 as groundwater perfused through sediments.

NO_3^- & SO_4^{2-}



Groundwater is likely source of NO_3 and SO_4. NO_3 was partially consumed or denitrified.

PO_4^{3-}



Sediment porewater is likely source of PO_4 as groundwater perfused through sediments.

Conclusions

Kellogg Forest Pond was not an ideal system to drain.

- Induced substantial grounwater/stream water inflow.

No sediment effect on water quality.

- Likely because we failed to drain porewaters completely and dry out the mucky delta.