

Aquatic Biogeochemistry update

Steve Hamilton



KBS LTER

Kellogg Biological Station

Long-term Ecological Research

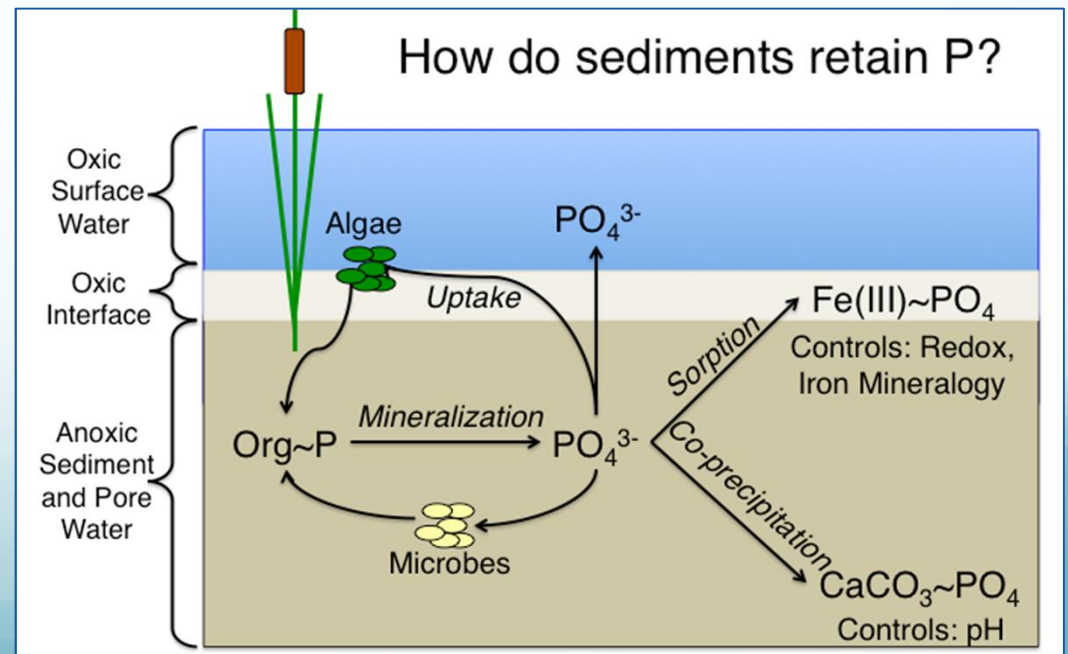
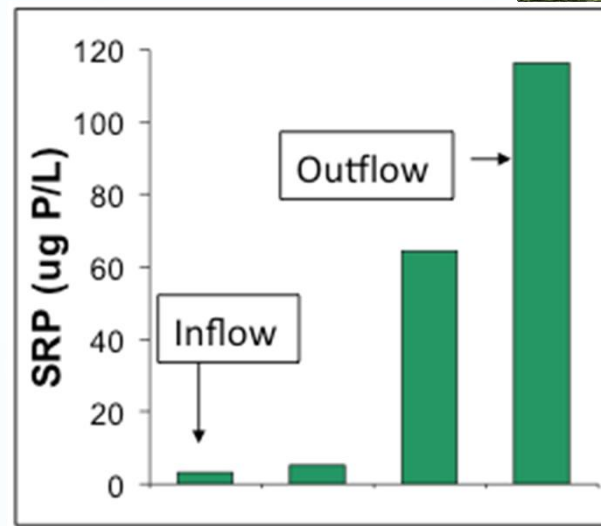
Key research areas

- Biogeochemical processes in surface waters that control water quality
- Landscape flows of water and materials as a function of land use and cover
- Invasive species effects on ecosystem processes
- Aquatic food webs in rivers: Effects of dams
- New since 2010! Impacts of a major tar sands oil spill in the Kalamazoo River



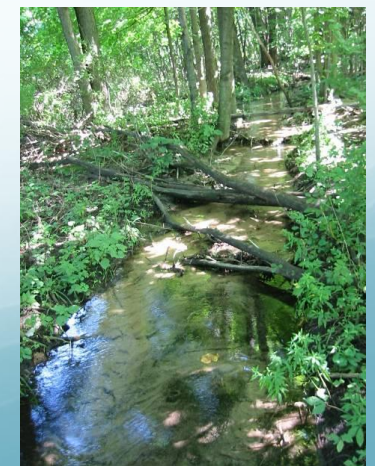
Wetland phosphorus cycling

- Water level variation
- Lauren Kinsman-Costello (PhD) and Jon O'Brien (postdoc)
- Manuscripts ready for review:
 - Effects of drying and rewetting of sediments in diverse water bodies
 - P dynamics upon reflooding a drained wetland at a military training area



LINX project: Final stretch

- NSF-funded Lotic Intersite Nitrogen Experiment (1998-2004)
 - 74 papers, over 130 scientists (79 grad students)
 - Included streams in Kalamazoo River watershed
- Most recent synthesis papers (2011-12):
 - Potential denitrification rates
 - Modeling N movement through river networks
 - Nitrous oxide emission from streams
 - Dissolved organic N production
 - LINX as example of successful collaboration
- Now working to make LINX data available online (Hamilton with Sherri Johnson, Linda Ashkenas)

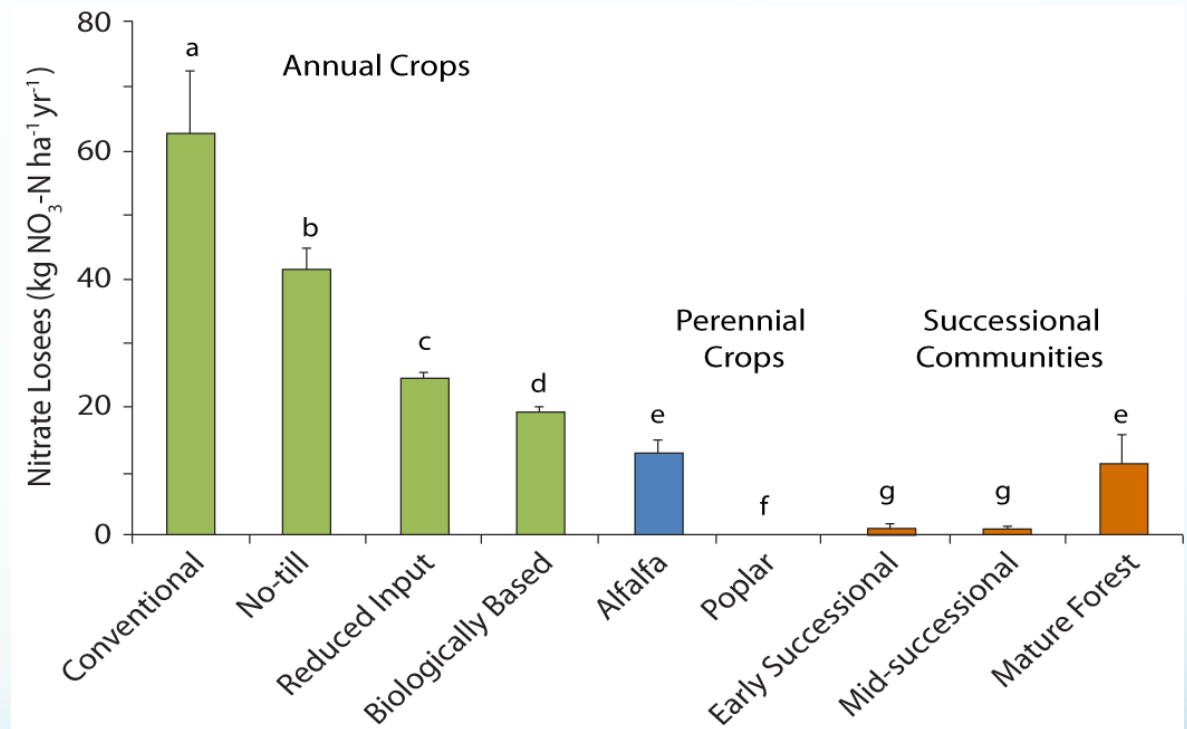


Tracing the N cycle in surface waters

- Understanding the fate of assimilated N in streams
 - O'Brien, J.M., S.K. Hamilton, L. Podzikowski, and N.E. Ostrom. 2012. The fate of assimilated N in stream biofilms: an *in-situ* benthic chamber study. *Freshwater Biology* 57: 1113-1125.
- Learning to conduct LINX-style ^{15}N addition experiments in wetlands and larger streams
 - O'Brien, J.O., S.K. Hamilton, L. Kinsman-Costello, J.T. Lennon, and N.E. Ostrom. 2012. Nitrogen transformations in a through-flow wetland revealed using whole-ecosystem pulsed ^{15}N additions. *Limnology and Oceanography* 57: 221-224.
- Pushing the analytical boundaries for measurement of the stable isotope ratio in dissolved N_2
 - NSF EAGER grant with Nathaniel Ostrom
 - Success would allow us to work in larger or more complex aquatic ecosystems

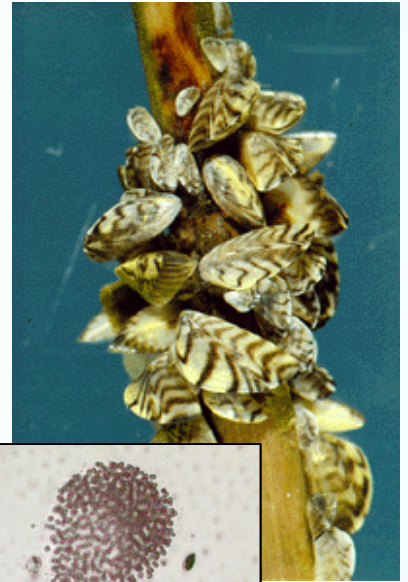
Nitrate-N leaching to groundwater

- Based on 11 years of LTER data
 - Syswerda S.P., B. Basso, S.K. Hamilton, J.B. Tausig, and G.P. Robertson. 2012. Long-term nitrate loss along an agricultural intensity gradient in the Upper Midwest USA. *Agriculture, Ecosystems & Environment* 149: 10-19.
- Soil water samplers (“suction lysimeters”) and SALUS model



Invasive species and ecosystem processes

- Zebra mussels and harmful algal blooms in Michigan lakes
 - Sarnelle, O., J.D. White, G.P. Horst, and S.K. Hamilton. 2012. Phosphorus addition reverses the positive effect of zebra mussels (*Dreissena polymorpha*) on the toxic cyanobacterium, *Microcystis aeruginosa*. *Water Research* 46: 3471-3478.
 - Mass die-offs in Gull Lake (2011 and 2012): Cause under study
- Invasive grasses in Michigan wetlands
 - Jason Martina's PhD; papers forthcoming

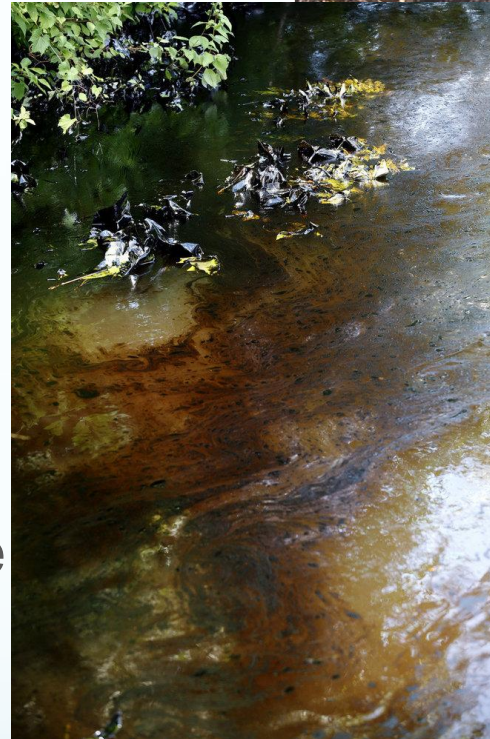


Other lines of research

- Sulfur-nitrogen linkages via microbial chemolithoautotrophic metabolism
 - Burgin, A.J., S.K. Hamilton, S.E. Jones, and J.T. Lennon. 2012. Denitrification by sulfur-oxidizing bacteria in a eutrophic lake. *Aquatic Microbial Ecology* 66: 283-293.
 - Burgin, A.J., W.H. Yang, S.K. Hamilton, and W. Silver. 2011. Beyond C and N: How the microbial energy economy couples elemental cycles in diverse ecosystems. *Frontiers in Ecology and the Environment* 9(1): 44-52.
- N processing as water moves through lakes
 - Bruesewitz, D.A., J.L. Tank, and S.K. Hamilton. 2012. Incorporating spatial variation of nitrification and denitrification rates into whole-lake nitrogen dynamics. *Journal of Geophysical Research – Biogeosciences*, 117, G00N07.
- Biogeochemical time lags
 - Hamilton, S.K. 2012. Biogeochemical time lags may delay responses of streams to ecological restoration. *Freshwater Biology* 57 (Suppl. s1): 43-57.

Kalamazoo River oil spill

- Largest inland oil spill ever occurred near KBS in 2010
 - Enbridge pipeline rupture
- First major spill of oil sands (tar sands) crude
- Cleanup still ongoing!
- Hamilton has provided scientific advice throughout the cleanup
 - Research to inform decisions
- Leila Desotelle's PhD now includes studies of impacts
 - Food web studies interrupted



Gull Lake Monitoring

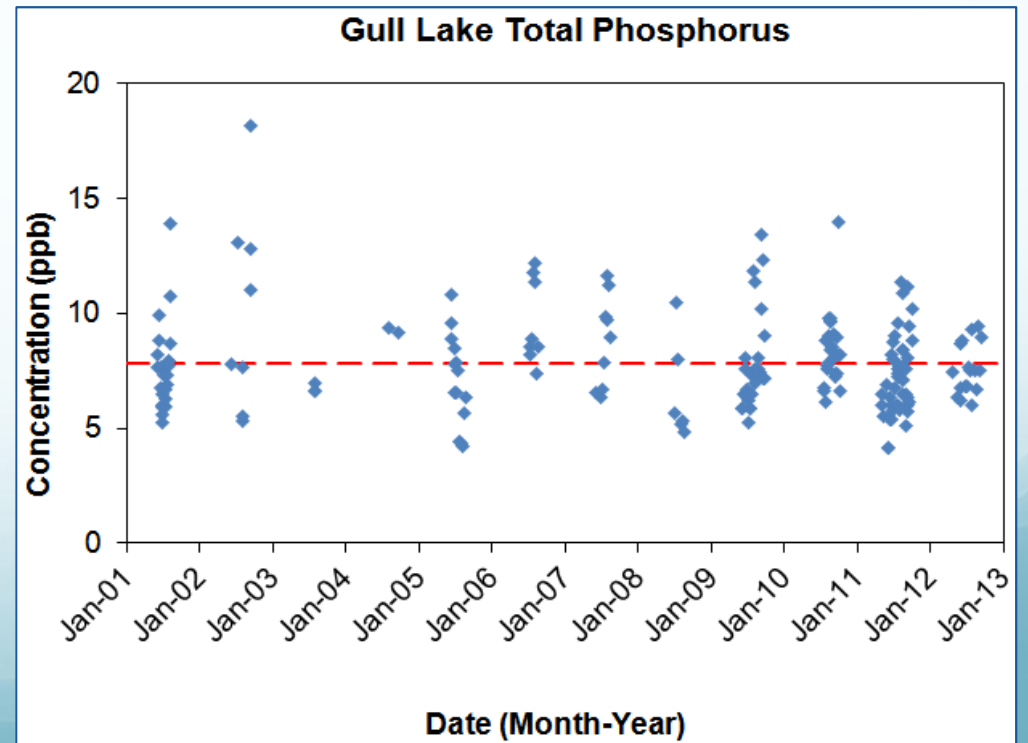
- Local lake association provides the impetus
- Funding for a summer grad assistantship since 2011
 - Jeff White of Fisheries & Wildlife Dept.
- Annual reports incorporate data from earlier research as well as new sampling
- glqo.org



GULL LAKE WATERSHED MONITORING PROGRAM 2012 ANNUAL REPORT

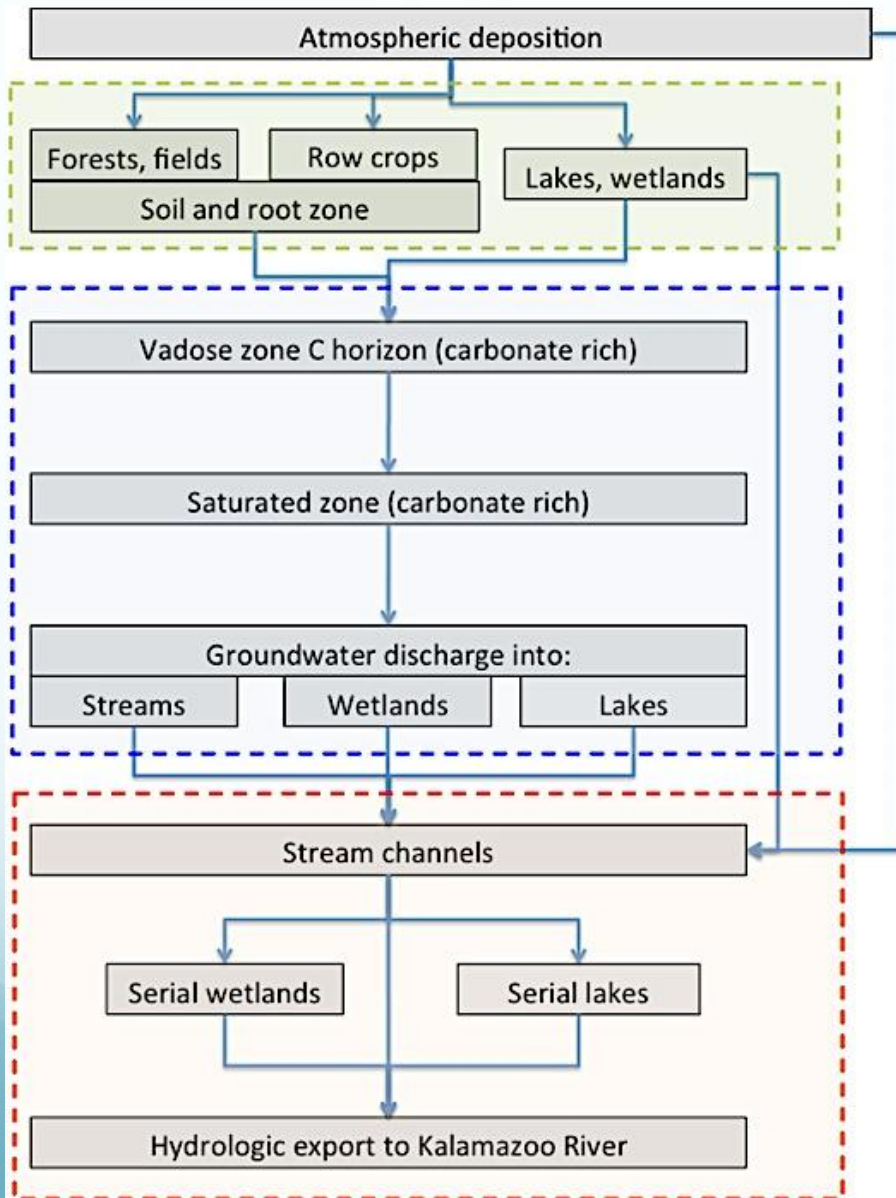


Dr. Stephen K. Hamilton, Kellogg Biological Station
Jeffrey White, Department of Fisheries & Wildlife
Michigan State University



Thank you!

Midwest Glacial Landscape Critical Zone Observatory?



- NSF proposal in review...
- Integrated analysis of landscape water flow paths
- Geoscience + ecosystem ecology approaches
- To be co-managed by David Hyndman (MSU GLG) and Hamilton
 - Other co-PIs include Bruno Basso, Michael Velbel, Phil Robertson