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Why Study Diatoms, You Ask?

Brad Hoge
Associate Professor of Natural Science and Science Education
Department of Natural Science, University of Houston-Downtown
Houston, Texas

Mitigation wetlands are constructed to replace the functions of natural wetlands destroyed by urban development. Wetland functions such as water retention and habitat stability can be measured once wetland construction is completed, which is why federal guidelines require annual monitoring for only 5 years. In these capacities mitigation wetlands are generally successful. Natural wetlands also segregate and break down pollutants and organic matter, however. While pollutant levels and other water quality parameters are often monitored in mitigation wetlands, the amount of organic matter sequestration and degradation is not usually quantified. Organic matter sequestration and degradation is particularly important in coastal regions, however, to reduce the biological oxygen demand on surrounding estuaries. This function relies on communities of anaerobic bacteria which produce highly reducing soils in natural wetlands. Organic matter broken down by microbial metabolic pathways leads to changes in soil biogeochemistry over time. This biogeochemistry can be studied directly, but the methods tend to be complex and expensive.

Hoge at Shoveler Pond in Anahuac NWR showing students a handful of sediment. This is the control site for the diatom climax community in the Trinity River Valley. Established in 1963, ANWR is the best example of nearly pristine fresh water marsh in the area. The diatom community in Shoveler Pond is still identical to the diversity observed in 1994, and in other natural wetlands in the area.
Photo credit: Kelly Colby.

When I was approached by the Harris County Flood Control District (HCFCD) to see if I would be interested in conducting research studies in the Greens Bayou Wetlands Mitigation Bank (GBWMB), it occurred to me that I could apply a method that I developed while doing research for my dissertation in the Anahuac National Wildlife Refuge and surrounding

watersheds within the Trinity River incised valley to the study of mitigation wetland soil profile development. The HCFCD constructed the GBWMB in northeast Harris County, Texas, near the city of Houston. The GBWMB is a 1,400-acre wetland project located approximately five miles southeast of Bush Intercontinental Airport, adjacent to Beltway 8 at the confluence of Garners and Greens Bayous. Water entering the GBWMB comes primarily from overflow of these bayous and storm water run-off from both urban and forested areas within the larger Trinity River valley.

Hoge at the same site on Shoveler Pond, ANWR, at the height of the drought. Though the ANWR served as the control site, the impacts of Hurricane Ike and the drought gave Hoge the opportunity to study the impact of the recovery process of the diatom community at this site. Hurricane Ike caused significant salt-water intrusion. The drought nearly drained the marsh. In both cases, it took nearly 2 years for the diatom community to recover to normal diversity. Photo credit: Kelly Colby.

Diatoms are useful bio-indicators for many environmental impacts, including biogeochemical changes, so I reasoned they could be used to study mitigation wetland soil profile development by tracking diatom community succession trajectory. While plant diversity was established during construction, diatom community succession should follow a natural succession as conditions of the soils change to reach stable conditions. Using paleoecologic methods that compare diversity trends in diatom death assemblages at the GBWMB to climax communities in the larger Trinity River valley, we have shown that GBWMB soils began functioning similarly to natural wetlands at approximately twenty years after construction. The total volume of carbon sequestration and degradation remains an order of magnitude lower, however, most likely due to lower sedimentation rates at the GBWMB which limits the depth of the soil profile. This function also appeared suddenly suggesting a boundary effect most likely related to an Eh threshold.

Our current studies are beginning to look at ecological edge effects on diatom community succession at the GBWMB by comparing surrounding watershed communities from various environments of deposition such as bayous, rivers, lakes, marshes, and swamps; as well as looking for trends in each of these watersheds which have been affected by urban development. Watersheds within the Trinity River valley include both natural areas as well as other mitigation sites of various ages. By applying our paleoecologic method to surface and core samples, we hope to build a three-dimensional database and eventually model edge effects throughout the entire Trinity River valley.

Hoge with students at another site on Shoveler Pond. The team had taken a core sample from the pond to be used to study community succession over the 50 year history of the site and to look for taphonomic affects. This is one of Hoge's favorite photos as it shows how vested the students are in the project. Students usually start out a bit skeptical about what they are doing, but are always surprised by how engaged they become collecting and counting diatoms. Photo credit: Kelly Colby.

The Society for Ecological Restoration, Texas Chapter promotes ecological restoration as a means of sustaining the diversity of life on Earth and re-establishing an ecologically healthy relationship between nature and culture.

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