The Fourth Biennial Conference of the Lake Erie Millennium Network (2006) – Poster Abstracts

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This document is an abstract digest of the poster presentations made during the 4th Biennial Conference of the Lake Erie Millennium network. The conference was co-convened by the University of Windsor Great Lakes Institute for Environmental Research, the National Water Research Institute, the Ohio Sea Grant - F.T. Stone Laboratory of Ohio State University, and the Large Lakes Research Station, US EPA of Grosse Ile.

For more information on the LEMN conference and workshop series, please visit the Lake Erie Millennium Network website: http://www.lemn.org

Poster Presentation Abstracts

Assessing Lake Whitefish spawning and nursery habitat in the Detroit River International Wildlife Refuge.

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The Huron-Erie Corridor Initiative, sponsored by the U.S. Geological Survey Great Lakes Science Center, addresses critical research issues affecting aquatic resources and environments in the Huron-Erie Corridor (HEC). The purpose of the Initiative is to create relevant new science, potential research strategies, and partnerships to better address the needs of fisheries and aquatic resource managers in the HEC. Herein we present three research initiatives examining fish habitat in the lower HEC. Studies on the recently constructed spawning reefs at Belle Isle in 2004 and 2005 revealed use by several species of fish including walleye, yellow perch, and suckers. These results mark the first verified incidence of walleye spawning in the river. Beginning in 2006, scientists at the USGS will undertake studies to assess spawning success of lake whitefish, walleye, lake sturgeon and other fish at sites in the lower Detroit River. This study is designed to assess habitat use, adult stock characteristics, spawning periodicity, and egg survival to provide the scientific community with important new information on the quality and quantity of fish reproductive habitat in the HEC. Coupled with the spawning survey is an assessment of larval fish transport and nursery habitat in the Detroit River. The larval fish study will examine species composition, succession, growth and survival rates, diet, and habitat connectivity of transient and residential ichthyoplankton in the river and western Lake Erie. Information from the larval fish study will be used to estimate the productive potential of fishes moving through the river, possibly providing an early indicator of year-class strength. These new research initiatives will provide scientists with needed new information on fish stocks and habitat in the HEC. These types of information are necessary to formulate management strategies to restore and protect fisheries as well as assess the progress of current efforts to rehabilitate fisheries in the HEC.

The influence of early diagenesis on trace metal and phosphorous cycling in Lake Erie sediments.

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Early diagenesis controls the fate and distribution of heavy metals and phosphorus (P) in sediments. Lake Erie receives significant inputs of anthropogenic heavy metals and P. To date there have been few studies of early diagenesis in Lake Erie. To assess these inputs and predict their impact it is important to understand early diagenesis in Lake Erie. To this end sediment samples were collected at four locations in the Central and Eastern basins during cruises of the R/V LIMNOS in May and June of 2004. Sediments were collected using a boxcorer preserving the sediment water interface (SWI) as best as possible. Porewaters were extracted by centrifugation under an inert N2 atmosphere. Trace metals in the porewaters were determined by ICP-MS and ICP-OES.

Vertical concentration profiles of Mn and Fe in pore waters are similar between stations. Mn displays sharp concentration gradients between 0 and 2.5 cm below the SWI. The concentration of dissolved Mn remains relatively constant at ~ 80 µM below a depth of 2.5 cm. Fe concentrations are low between 0 to 11 cm (~30 µM) and increase to greater than 250 µM below 12cm. This suggests that the upper ~20 cm of sediment can be divided into three zones: 1) 0-2cm below the sediment is a zone of aerobic respiration and Mn oxidation; 2) between 2 and 12 cm is a zone of Mn reduction; and 3) below 12cm is a zone of Fe reduction. Measurements with microelectrodes suggest that sulphide reduction is restricted to micro-environments, possibly enriched in organic carbon. This sulphide is re-oxidized in the aerobic zone as a result of bioturbation. Ni and Co porewater concentrations exhibit sharp peaks within the zone of Mn reduction. These peaks are consistent with the reductive dissolution of Ni and Co-bearing Mn oxides just below the zone of aerobic respiration. The sharp decrease in Ni and Co below this zone is consistent with co-precipitation in authigenic carbonate phases resulting from increased alkalinity. Alternatively, these peaks may be the result of the oxidative dissolution of Ni and Co bearing sulphide minerals and removal below the SWI by sorption to Mn oxides.

Policy trends and value of quality management for researchers in Lake Erie.

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Recent trends in government policies are increasing emphasis on the quality and transparency of information and on the results of environmental programs. As federal agencies are under increasing scrutiny and programmatic success becomes more closely tied to budgets, the need for a quality system is reinforced. Also, as data becomes available on-demand, and data users grow more sophisticated, it becomes increasingly important to document the ways in which EPA data should and should not be used. Thus, EPA is revising its agency-wide Quality policy to encompass some of these developments, including the Information Quality Guidelines, updates to the Peer Review Handbook, and a life-cycle approach to data management. The Great Lakes National Program Office (GLNPO) emphasizes a value-added approach to quality management, where systematic planning and assessment are tools to assist in the successful project implementation. Several examples of Lake Erie projects will be shown. The ultimate goal of the quality system is for decisions to be based on data of known and documented quality. When this occurs, the quality system works to enhance the quality of EPA's information and results of its programs.

Population size and recovery of the Lake Erie watersnake: integrating multiple methods of population estimation.

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Quantitative estimates of abundance are central to management of threatened and endangered species but may be difficult to obtain for rare secretive organisms. Estimates of adult population size for the federally threatened Lake Erie watersnake were computed using mark-recapture data from area-constrained searches of 21 study sites on 9 islands encompassing >25 km of shoreline and spanning 25 years. Watersnakes were hand captured and marked by scale clipping (1980-1992) or PIT tags (1996-2000), providing data on 5441 captures of 4168 adults. Population estimates were generated using Pollock's 'robust design' from a combination of secondary (within-year) and primary (among-year) population censuses. Closed population methods (Lincoln-Petersen, Schumacher's) were used for within-year censuses and open population methods (Jolly-Seber, Bailey's triple-catch) were used for among-year censuses, providing 121 point estimates. Paired t-tests comparing alternative methods were consistently non-significant, suggesting that the no-recruitment assumption of closed population methods was met. At 11 sites encompassing 15.8 km of shoreline for which recent (2000-2004) mark-recapture estimates were available, population density was highly correlated with capture rate ($r = 0.90$). The regression relationship between density and capture rate was thus used to estimate population size at 19 additional sites (19.6 km of shoreline) based on capture rate alone. Together, mark-recapture and capture rate estimates totaled more than 6500 adults, exceeding the overall number (5555 adults) specified in the Population Persistence criterion of the Lake Erie Watersnake Recovery Plan. Actions related to other criteria (Habitat Protection and Management, Reduction of Human-induced Mortality) and a capacity for rapid population growth make recovery and eventual delisting of the Lake Erie watersnake a real possibility.

Population genetic divergence patterns of invasive round gobies in Lake Erie versus the other Great Lakes.

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Genetic variability and population structure are compared among population sites of the round goby (Apollonia – formerly Neogobius - melanostomus) in Lake Erie versus Lakes St. Clair, Huron, and Michigan using mitochondrial DNA sequences of the cytochrome b gene and control region, and four microsatellite loci. The round goby invaded the Lake St. Clair region North American Great Lakes from Eurasia via ballast water in the early 1990s, and quickly spread throughout the Great Lakes. The null hypothesis of the present study is that genetic variability in these invasive sites is predicted to be relatively low and relatively uniform in composition across the Lakes, reflecting the likelihood of only a few individuals becoming established. Conversely, higher genetic diversity may provide raw material for a species' invasive and establishment success. Our results show that a surprisingly diverse number of haplotypes characterize invasive populations from all Great Lakes sites analyzed, showing little or no founder effect in comparison with native populations. Additionally, results reveal significant differences among locations in the various Lakes, suggesting that multiple founding sources and introduction events were involved. This high genetic variation likely led to the tremendous invasive success of the round goby in the Great Lakes. In addition, some genotypes already in the Great Lakes are also common in the Black Sea, suggesting that the round goby will likely become established in estuarine habitats along North American coasts – given transport and the opportunity.

Horizontal characterization of phytoplankton community composition and health.

Twiss, M.R., D.I. Page, S.M. Havens, G. Silsbe, and R.E.H. Smith

Genetic variability and population structure are compared among population sites of the round goby (Apollonia – formerly Neogobius - melanostomus) in Lake Erie versus Lakes St. Clair, Huron, and Michigan using mitochondrial DNA sequences of the cytochrome b gene and control region, and four microsatellite loci. The round goby invaded the Lake St. Clair region North American Great Lakes from Eurasia via ballast water in the early 1990s, and quickly spread throughout the Great Lakes. The null hypothesis of the present study is that genetic variability in these invasive sites is predicted to be relatively low and relatively uniform in composition across the Lakes, reflecting the likelihood of only a few individuals becoming established. Conversely, higher genetic diversity may provide raw material for a species' invasive and establishment success. Our results show that a surprisingly diverse number of haplotypes characterize invasive populations from all Great Lakes sites analyzed, showing little or no founder effect in comparison with native populations. Additionally, results reveal significant differences among locations in the various Lakes, suggesting that multiple founding sources and introduction events were involved. This high genetic variation likely led to the tremendous invasive success of the round goby in the Great Lakes. In addition, some genotypes already in the Great Lakes are also common in the Black Sea, suggesting that the round goby will likely become established in estuarine habitats along North American coasts – given transport and the opportunity.

Rates of Delivery of Organic Carbon and Nutrients to the Hypoxic Region of Lake Erie.

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Lake Erie is unique in several ways among the Laurentian Great Lakes. In this study, we explore the rates of delivery of mass and nutrients in two of these areas. The Central Basin, where a shallow hypolimnion leads to annual summer anoxia/hypoxia, and the deep hole in the Eastern Basin where sediments accumulate at a greater rate than anywhere else in the open Great Lakes. Being the shallowest of the Great Lakes, Erie has frequent and extensive sediment resuspension events and is thus tightly coupled to the legacy of nutrients and contaminants stored in exchangeable sediments. In this study, sediment traps were deployed at a depth of 5m above the bottom in the central and eastern basins (recipient of transport from the CB) to measure the rates of delivery of mass, organic matter and nutrients. The trap moorings were deployed adjacent to moorings equipped with a vertical profile of transmissometers and a bottom-mounted ADCP. The moorings covered the period from mid-April 2004 through mid-April 2005.

CB fluxes ranged from 0.8 to 37 g/m2/d over 9 day collection intervals, with peaks in the fall-early winter, declining to a minimum after ice covers the lake. Higher fluxes reappear after ice out in the spring. Pulses in the transmissometer record clearly illustrate that the elevated fluxes recorded in the traps often correspond to brief events. During the ice covered period the fluxes gradually declined over a period of a month. Since there was no wave activity during the ice-covered period, this decline provides an estimate of the overall settling times for the water column particle pool. The mean mass flux of 11.6 g/m2/d had an average of 3.2% organic carbon resulting in an average organic carbon flux of 423 mgC/m2/d. The OC concentration ranged from 2.2 to 4.0 %, with the highest values in April 2005. Lowest concentrations were in January. These concentrations are similar to values measured over the years in surface sediments within approximately 2 miles of the trap location (2.4 – 3.2 %). From the preliminary data, the CB near-bottom trap accumulates more mass than the deep EB site, although the sediments accumulate more rapidly at the EB site. The difference between the trap and sediment accumulation

was much larger at the CB site, implying extensive local resuspension. The same applies to both organic carbon and total phosphorus fluxes. C/P for both traps is approximately 24, while the C/P for sediments at the CB is 30 and for the EB is over 100. This implies that the trap organic matter is less degraded, likely a contribution from freshly settling materials

Historical sedimentation rate determinations in Lake Erie.

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Estimates of sedimentation rates in Lake Erie are available from several historical data sets. The most complete set of cores for determining long-term permanent mass accumulation rates using Pb-210 and Cs-137 geochronologies were collected as part of a research cruise carried out in Lake Erie in 1991 aboard the R/V Neeskay. These data have been reexamined and archived samples analyzed to establish sedimentation rates at approximately 40 stations during the early part of the zebra mussel colonization of Lake Erie. Sedimentation rates ranged from ~ 20 to over 1000 mg cm-2 y-1 in the depositional areas of the lake. The upper end of this range occur within the deep eastern basin of Lake Erie and are among the highest sediment accumulation rates found anywhere in the Great Lakes. Comparisons with earlier measurements conducted in 1976 are being made.

Natural modification of tributary spawning habitat for smallmouth bass and walleye following removal of St. John's Dam, Sandusky River, Ohio.

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Physical changes in stream substrate, stream morphology, and habitat following removal of the St. John's dam are based on field mapping conducted in 2003 (before dam removal), 2004, and 2005. Field mapping was performed using a modified version of the method developed by Mackey, Foye, and Davies, and Wells (2001). This poster illustrates the methodology used to derive potential smallmouth bass and walleye spawning habitat and shows the changes in this habitat in three successive years.

Field Methods. Physical mapping was accomplished using the most recent, available, aerial photography acquired through county and state agencies. For the Sandusky River St. John's Dam area, State Plane NAD 83 Ohio North grid was overlain on the aerial photography and printed to take in the field to correlate collected Global Positioning System (GPS) line and point data with the correct location on the field maps. Two sets of field maps consisting of the river reaches in the study areas, were printed and coated with a clear protective acrylic finish to make the field maps water resistant. During mapping, the substrate contacts were drawn on one set of maps and the morphology was drawn on the second set of maps. Geographic coordinates were collected with a Trimble GPS Pathfinder Pro XRS® to place baseline data on field maps and to map reaches with complicated substrate and morphology. Two methods of collecting data were used depending on river conditions. Reconnaissance mapping was required when the river reach was too deep and/or swift to walk the contacts. Reconnaissance mapping was completed from a boat or canoe, using 1" diameter aluminum pipe to probe the channel bed to identify substrate contacts. Detailed mapping was completed on foot, using GPS to collect line and point data of most substrate and morphology contacts. Detailed mapping methods were preferred and used when the river could be walked.

GIS Methods. After fieldwork was completed, the baseline substrate and morphology data were transferred into GIS. These data were digitized on screen as separate polygon shapefiles to produce separate substrate and morphology layers to overlay on aerial photography. Spawning substrates preferred by smallmouth bass and walleye are boulder, cobble, and gravel and preferred morphologies are runs and glides. By overlapping the preferred substrate with the preferred morphology in GIS, potential spawning habitat for smallmouth bass and walleye were identified and delineated both upstream and downstream of the dam.

Results. Preliminary results of the pre- and post-dam removal surveys collected in the Mexico Bridge reach, 7 miles upstream of the former dam, show: 1) Cobble and gravel substrate, increased in 2004, a year after dam removal, but decreased in 2005; 2) Sand and mud substrate decreased from 2003 to 2004, but increased in 2005. Documented changes in substrate, which drives changes in potential habitat, indicate potential spawning habitat increased 7 miles upstream of the dam, the first year after removal, but then decreased the second year after removal. This is likely because boulder, cobble, and gravel, the prime spawning substrates, moved through this reach in 2004. It is probable that the river is still adjusting to the removal of the dam. An additional three-years of monitoring is planned to document longer-term changes in potential habitat and to refine guidelines for monitoring programs.