Mid-Year Report for:
Project Number 2001.68

AN ECOLOGICAL ASSESSMENT OF THE MUSKEGON RIVER WATERSHED TO SOLVE AND PREVENT ENVIRONMENTAL PROBLEMS

and

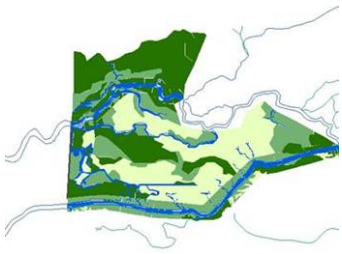
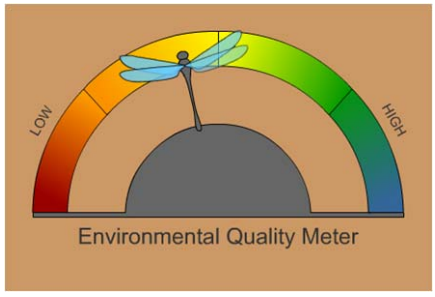
FISH RECRUITMENT AT THE INTERFACE OF THE GREAT LAKES AND THEIR WATERSHEDS

Michigan State University
July 30, 2006







The following report describes project progress since the last annual report (January 2006) to this date (July 30, 2006). The report is prepared in 2 parts. The first covers the objectives of the Muskegon River Watershed Assessment for the entire watershed. The second covers the tasks and objectives for the second part of our project related to Fish Recruitment at the Interface of the Muskegon River and Lake Michigan. The report is organized by objective in the first part about the Assessment and by Task in the second part about Fish Recruitment.

Overall, we are largely done collecting data, but a few outstanding efforts remain. We are in the process of revisiting all tasks and determining endpoints and products and timing for each of them. We expect to have that schedule developed by the end of August.

MUSKEGON RIVER WATERSHED ASSESSMENT

Objectives

1. assess and monitor the ecological health of streams, lakes, and wetlands throughout the MRW using a tiered, integrated approach with citizens and experienced scientists;
2. develop regionally-defined, quantitative relationships between ecosystem attributes, specific pollutants, and human activities that can be used in management models;
3. develop monitoring technologies that will enable continuous assessment of ecosystem processes at the land-water interface; and
4. increase public awareness of intrinsic values of MRW ecosystems and the science used to make management decisions.

Performance Measures

Objective 1: We've had a few set-backs, hold-ups, and successes with tasks for objective 1. First, a couple of our papers that we submitted for publication were rejected from the journals that we selected for submission. The reviews were helpful for guiding revisions during resubmission to journals for publication. On the positive side, papers have been accepted for publication during the last 6 months.

We have not made as much progress as we planned for developing assessments of the aquatic habitats in the Muskegon and posting them on the web. This has been due to having the opportunity to get updated land use land cover information that is important in the assessment. In addition it has taken longer than expected to get the data assembled in a database that will enable the analyses that we need. We've coordinated the role out of this information with the Mega-model stakeholder meetings.

Objective 2: We continue our efforts with MDEQ nutrient criteria development and application of the Muskegon River results. This effort has required incorporating the Muskegon data with other data from the state, which strengthens both Muskegon and state efforts. We expect these analyses to be completed by early September and reports by the end of the year.

Objective 3: Dr. Gage has provided a separate summary report on the development of acoustics techniques for environmental assessment. That report is available on the MRWEAP website.

Dr. Narumon Wiangwang completed her Ph.D. requirements, with the guidance of Dr. Qi, by submitting her dissertation to MSU. Nok (Narumon) studied the use of remote sensing to

assess water quality in lakes, most of which were in the Muskegon Watershed. Lakes outside the watershed were used to ensure a broad range of conditions. Nok identified seven spectral bands that were most sensitive to changes in water quality, specifically water clarity and chlorophyll a concentration. Both these variables can be assessed with satellite remote sensing fairly accurate, with r^2 as high as 0.84. Broader band widths were better correlated to water quality variables than narrow band widths. She also refined the statistical analysis techniques for remote sensing data to increase the precision and accuracy of water quality inference models. Nok has returned to Thailand where she plans to complete writing 3 papers from here dissertation. More details of Nok's results are available upon request and we can provide a copy of her defense presentation. This will complete the goals of this objective under the Assessment part of the project. Nate Torbick, a second of Dr. Qi's students, is continuing his work on remote sensing of wetlands and community composition. This work actually falls under funded efforts of the Lower River Fish Recruitment.

Objective 4: As mentioned under Objective 1, we have gathered new data to complete assessments, but have postponed putting the assessment onto the web until the data has been analyzed more completely. We'd prefer to have a good assessment posted on the web to begin with rather than post a preliminary assessment and then have to update it as new information and were under development. We plan coordinate posting all assessments on the web as well as a summary report when stakeholder communications are started with the Mega-model project.

FISH RECRUITMENT AT THE INTERFACE OF THE GREAT LAKES AND THEIR WATERSHEDS

Progress continues to be made on the following tasks identified in the "Addendum to enhance current projects of the Muskegon River Initiative." To provide an overview of the task structure of the whole project, all tasks will be described and addressed, at least briefly, to describe who is doing them and future plans.

Task 1. Develop and adapt models for key fishes.
This part of the project is largely the responsibility of scientists at The University of Michigan. These tasks will be addressed during the coming year now that information has been gathered.

Task 2. Identify and map major macrohabitats in Lower Muskegon River Watershed
This task is in the analysis stage. Most data have been collected. The next steps are to interpret the data and describe the area, location, and connectivity of habitats along flow paths. These data will be linked to biological productivity data that were gathered in Task 3 and linked to the fish models.

Task 3. Collect the necessary biological and physical habitat data for models
Subtask 3.2 Measure algal and plant biomass, productivity, and species composition in habitats throughout the lower Muskegon Estuary system (Stevenson and students-MSU; Steinman-GVSU)

We have completed data collection for inland habitats for this task, but have extended the efforts for the nearshore zone of Lake Michigan. Dr. Lougheed is leading an effort to synthesize the data into a report and paper for submission in peer-reviewed journals.

Subtask 3.3 Characterize seasonal benthic prey availability in macrohabitat units (Burton-MSU; Uzarski-GVSU)

The field and laboratory portions of this work have been completed. The next steps are gathering the data and entering it into the project database. Then Drs. Burton and Uzarski plan to write papers on this work and help us integrate it into the Lower River fisheries modeling effort.

Subtask 3.5 Characterize seasonal and diel variability in O_2, soundscapes, and water chemistry
This subtask was completed last year.

Task 4. Enhance current transport modeling of water and solutes for MREMS
Subtask 4.1 Detail hydrologic routing influences on material flux and delivery rates
(UM Richards, MSU Hyndman, GVSU Rediske, NOAA Eadie)
Dr. Hyndman continues to work with the Mega-Model team to refine hydrologic models for Michigan landscapes and apply them to Muskegon watersheds. Progress under this task has been described by Wiley et al. in the Mega-Model report.

Task 5. Estimate stage and habitat-specific abundances, growth, and survival rates of fish
This part of the project is largely the responsibility of scientists at The University of Michigan.

Task 6. Determine habitat specific food-webs
Subtask 6.3 Elemental analyses focusing on toxic metals.

Fish samples are being collected this summer for analysis of toxic metals. Analysis of samples is planned for this fall.

Task 7. Collaborative study on bank erosion and fish habitat
This part of the project is largely the responsibility of scientists at The University of Michigan.

Task 8. Integrate fisheries models into MREMS
This part of the project is largely the responsibility of scientists at The University of Michigan. However Dr. Pijanowski is supported partially for the land-transformation modeling through the MSU subcontract. His efforts under this task have been described by Wiley et al. in the Mega-Model report.

Task 9. Evaluate historic and paleolimnological records
Subtask 9.2 Evaluate paleolimnological records for changes in loading and human activities
Dr. Long has been spearheading the effort to collect a long core from Muskegon Lake. During early July he fought off bad weather with his crew and refined methods for taking the long core. He plans to collect the core during August 2006. Analysis of chemical signatures, diatoms, and other proxies that help predict ecological conditions in Muskegon Lake will be completed during the following 6 months.

Task 10. Assess algae and invertebrates in the nearshore zone of Lake Michigan

Subtask 10.4 Assess the spatial and temporal patterns in benthic and planktonic alga, and macroinvertebrates in the nearshore zone. (Stevenson and Burton-MSU, Steinman Uzarski, Rediske- GVSU)

Using the R.V. Jackson, based out of the Annis Water Research Institute (GVSU) in Muskegon, we collected nearshore benthic and planktonic algae samples in shoreline surveys to determine the importance of productivity of these 2 habitats, during 3 seasons, at different distances from the outlet of Muskegon Lake, and at different depths. We collected samples at 24 sites north and south of the Muskegon River in the nearshore zone of Lake Michigan during spring and early summer. We also plan late summer and fall trips. These sites are located at 6 distances from the River and 2 distances from shore to determine effects of depth. These samples are being analyzed as they are collected. Analyses should be complete by the November 2006.

Task 11. Expand study of Lake-River interactions to other watersheds.
This effort will be undertaken starting this fall, when most of the analyses of the MRW and MRW-lake interactions have been complete or are well underway.

MULTI-TASK MEASURES:

Since the last report, multiple presentations have been made at meetings, and several papers have been prepared and submitted for publication. The list of paper submitted is listed below with an update of status of past submissions.

Many students at varying levels of education have had the opportunity to conduct research and gain experience in ecological research with funding from this project. Their names also are listed below.

Personnel

Personnel, Principal Investigators
R. Jan Stevenson – Michigan State University
Tom Burton - Michigan State University
David Hyndman – Michigan State University
David T. Long - Michigan State University
Vanessa Lougheed, University of Texas, El Paso
Bryan Pijanowski – Purdue University
Alan Steinman – Grand Valley State University
Don Uzarski – Grand Valley State University

Personnel, Graduate Research Assistants active during last 6 months
Narumon Wiangwang - Ph.D. Graduate research assistant
Nathan Torbick – Ph.D. Graduate research assistant Merideth Lindeman Fitzpatrick – MSU Ph.D. student
Colleen McLean Jones - MSU Ph.D. Student
Anthony Kendall – MSU MS Graduate Student
Dush Jayawickreme – MSU MS Graduate Student

Personnel, Undergraduate Research Assistants active during last 6 months

Kevin Geyer - MSU

Personnel, Technicians
Mary Ogdahl - GVSU

Papers in Review, Submitted, or Ready for Submission for Publication in Peer-Reviewed Venues:

Stevenson, R.J., M.J. Wiley, S.H. Gage, V.L. Lougheed, C.M. Riseng, P. Bonnell, T.M. Burton, R.A. Hough, D.W. Hyndman, J.K. Koches, D.T. Long, B.C. Pijanowski, and J. Qi, A.D. Steinman, and D.G. Uzarski. in press. Watershed Science: Essential, Complex, Multidisciplinary and Collaboratory. In: S. Bao and W. Ji. eds. Proceedings of the Poyang Lake Conference.

Wiley, M., B. Pijanowski, R.J. Stevenson, P. Seelbach, P. Richards, C. Riseng, D. Hyndman and J. Koches. accepted. Integrated Modeling of the Muskegon River: Ecological Risk Assessment in a Great Lakes Watershed. In: S. Bao and W. Ji. eds. Proceedings of the Poyang Lake Conference.

Fitzpatrick, M.L., D.T. Long, and B.C. Pijanowski. Submitted. Characterizing biogeochemical fingerprints of land use on surface water quality across a regional watershed in the Upper Midwest, USA. Applied Geochemistry

Torbick, N., J. Qi, and R. J. Stevenson. 2006. accepted. Investigating wetland changes and wetland stress resulting from land use land cover changes in the Muskegon River Watershed.

Becker, B., Torbick, N., Lusch, D., Qi, J. 2006. Identifying optimal spectral bands from hyperspectral measurements of Great Lakes coastal wetlands using principal components analysis and second-derivative analysis (in prep).

Qi, J. and S. Gage, 2006, 2006, Soundscape Characteristics of an Environment: A New Ecological Indicator of Ecosystems Health, In Wetlands and Water Resource Modeling and Assessment: A Watershed Perspective. Higher Education Press (submitted).

Kendall, A. D., and D. W. Hyndman, (submitted), Examining Watershed Processes Using Spectral Analysis of Hydrologic Time Series, Water Resources Research.

Welty, N. R., D. W. Hyndman, R. J. Stevenson, (revised after review), Investigating Linkages Between Land Use and Ecosystem Stressors, Journal of Environmental Quality.

Jayawickreme, D. H., and D. W. Hyndman, (revised after review), Evaluating the Influence of Land Cover on Seasonal Water Budgets using NEXRAD and Stream Flow Data, Water Resources Research.

Lougheed, V. L., C. A. Parker, and R. J. Stevenson (accepted). Evaluation of rapid assessment techniques for establishing wetland condition on a watershed scale**.** In: S. Bao and W. Ji. eds. Proceedings of the Poyang Lake Conference.

Lougheed, V. L., C. A. Parker, and R. J. Stevenson. (rejected and in revision for resubmission). Using non-linear responses of multiple taxonomic groups to establish criteria indicative of wetland biological condition**.**

Lougheed, V. L., C. A. Parker, and R. J. Stevenson (rejected and in revision for resubmission). Contribution of small, isolated wetlands to local and landscape-level biodiversity.

Theses completed involving MRW research:

Wiangwang, Narumon. Assessment of Hyperspectral Data for Water Quality Studies in Michigan's Inland Lakes. Ph.D. Dissertation. Michigan State University.