

FINAL REPORT: Assessing the condition of Great Rivers using benthic and planktonic algal indicators

Submitted to: Brian H. Hill (Project Officer), U.S. EPA, Duluth, MN

U of M Grant Number: 3002-10425-01896289

Date: 9 October 2013

Submitted by: Euan Reavie, Center for Water and the Environment, Natural Resources Research Institute, University of Minnesota Duluth, 1900 E. Camp St. Ely, MN 55731; Phone 1.218.235.2184, Fax 1.218.235.2186; Email ereavie@nrri.umn.edu

The U.S. Environmental Protection Agency Environmental Monitoring and Assessment Program embarked on a comprehensive survey of Great Rivers in order to provide tools the states need to better manage and protect these important national resources. This survey collected indicators intended to measure the health status of the Missouri, Mississippi, and Ohio Rivers. Measured parameters included indicators of water quality, sediments, algae, plants, insects, and fish. The Natural Resources Research Institute developed indicator tools from the algae, collected from hundreds of sites throughout the Great Rivers system. Indicators are now available to track ecological quality using periphytic and phytoplanktonic algal assemblages. These indicator approaches will support future monitoring and paleoecological programs, and be used to identify and verify reference locations in rivers.

Algae are well-known to respond to stressors in rivers such as nutrient and salinity loading, siltation, and other factors affecting water clarity. We took a comprehensive approach to develop indicators (metrics and indices) for large river ecosystems using proven methods suitable for large rivers nationwide. A multi-tiered approach integrating landscape, biological communities, and chemical characteristics was applied to characterize sites.

The objectives of this study were as follows, with completion status in capital letters.

- quantify the extent to which anthropogenic stressors and natural gradients influence algal community structure in the Missouri, Upper Mississippi, and Ohio rivers (COMPLETED);
- develop predictive models through multivariate analyses of algal communities and ecosystems to describe reference conditions, trends, and magnitudes of disturbance in river ecosystems (COMPLETED);
- estimate the range of conditions and distribution of river reaches with varying degrees of habitat quality (COMPLETED);
- develop tools of state indicators of environmental disturbance in Great River systems for application by federal and state agencies (COMPLETED);
- develop integrated indices of biotic integrity based on a combination of selected metrics developed in the algal subprogram and by other teams in the Omnibus Project (including vegetation, water quality, zooplankton, macroinvertebrates, and fish) (PARTLY COMPLETE, BUT LESS INTENSIVE THAN PLANNED DUE TO FUNDING REDUCTION);
- develop a quality assurance/quality control (QA/QC) infrastructure for the algal subprogram and future assessment efforts (QA/QC PROTOCOL WAS MET FOR ASSESSMENTS, BUT DEVELOPMENT OF FUTURE STANDARD OPERATING PROCEDURE IS INCOMPLETE DUE TO FUNDING REDUCTION);
- apply of the algae indicators (i.e., diatoms) to validation of reference sites using paleoecological approaches (INCOMPLETE DUE TO FUNDING REDUCTION).

To date six articles from this project and involving the algal indicator team have been published, are in review, or will be submitted soon:

1. Kireta, A.R., E.D. Reavie, G.V. Sgro, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2011. Diatom-based stressor indicators for North American great rivers (in preparation).
2. Angradi, T.R., D.W. Bolgrien, T.M. Jicha, M.F. Moffett, M.S. Pearson, D.L. Taylor, J.M. Lazorchak, D.M. Walters, B.H. Hill, K.A. Blocksom, E.D. Reavie, A.R. Kireta, C.M. Elonen, L.E. Anderson, T.P. Hollenhorst 2011. Biotic indicators of condition and their response to stressors in North American mid-continent great rivers (USA). *Environmental Management* (in review).
3. Reavie, E.D., S. Juggins 2011. Sample size and diatom-based indicator model performance in five North American training sets. *Aquatic Ecology* (in review).
4. Kireta, A.R., E.D. Reavie, G.V. Sgro, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2011. Planktonic and periphytic diatoms as indicators of human stress on United States great rivers. *Ecological Indicators* (in press).
5. Sgro, G.V., E.D. Reavie, A.R. Kireta, T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2010. Comparison of diatom-based indices of water quality in the Upper Mississippi River Basin. *Journal of Environmental Indicators* 5(1): 48-67.
6. Reavie, E.D., T.M. Jicha, T.R. Angradi, D.W. Bolgrien, B.H. Hill 2010. Algal assemblages for large river monitoring: comparison among biovolume, absolute and relative abundance metrics. *Ecological Indicators* 10: 167-177.