

Upper Mississippi River Clean Water Act Biological Assessment Implementation Guidance Project



Background

Biological measures are often seen as the most direct and meaningful tools for assessing a water body's health. The states of the Upper Mississippi River (UMR) have not utilized biology in their Clean Water Act (CWA) assessments of the UMR to date. However, the UMR states are interested in examining the benefits and challenges associated with integrating biological information into these assessments.

The Upper Mississippi River Basin Association (UMRBA) Water Quality Task Force (WQTF) and Water Quality Executive Committee (WQEC) seek to improve implementation of the states' UMR CWA programs. In response to the UMR states' interest in biological assessment, UMRBA engaged the Midwest Biodiversity Institute (MBI) in a project to develop a UMR CWA Biological Assessment Implementation Guidance Document. The Guidance Document and associated project work are summarized here.

Purpose and Scope

The Guidance Document is intended for the states' use as they consider integrating biological information into their UMR CWA programs. It is focused on the interstate UMR main channel and is scoped to evaluate existing methods and indices. Specifically, the Guidance Document is designed to:

1. identify the scientific and regulatory issues with applying biological measures;
2. gauge the suitability of existing biological methods and indices for assessing aquatic life uses in the UMR main channel; and,
3. provide guidance to the states regarding the implementation of UMR CWA biological assessment.

Project Process and Reports

The Guidance Document summarizes research conducted by MBI and also reflects input from an interagency, interdisciplinary group of project participants who gathered for three working sessions during the project. The UMRBA WQTF also held additional discussions throughout the project.

The project's work and outcomes are documented not only in the Guidance Document itself, but also in two supporting reports, one examining CWA biological attainment thresholds and another offering a preliminary biological condition gradient (BCG) for the UMR. The Guidance Document and two supporting reports are available on UMRBA's website (www.umrba.org). The document's contents are described on the following pages.

Major Elements, Findings, and Recommendations

UMR Programs Overview

An extensive scientific, regulatory, and institutional setting is in place on the UMR. As such, monitoring and assessment on the River is certainly not a "blank slate" and understanding the current structure of UMR monitoring and assessment was a critical first step. An extensive survey at the project's outset showed that the UMR has been (and continues to be) the subject of extensive monitoring and research at many times, by many entities, and at various levels of government. No fewer than 14 major programs are currently or have recently been engaged in UMR monitoring and assessment for various purposes and under differing mandates. See the table on the following page for further details.



The health of macroinvertebrate, fish, and vegetation communities can all be indicative of the condition of the Upper Mississippi River. (Photos courtesy of USGS, USFWS, and NPS, respectively.)

Current and Recent Major UMR Monitoring and Assessment Programs

Level	Agency	Program	Monitoring*	Assemblages**
Federal	U.S. EPA	EMAP-GRE***	Bio, Chem, Phys	Fish, Mac, Ppt, Pkt, SAV
		NRSA	Bio, Chem, Phys	Fish, Mac, Ppt, Pkt
	USGS	NASQAN	Chem, Physical	None
	USACE	EMP-LTRMP	Bio, Chem, Phys	Fish, Pkt, SAV
		Program-Specific	Chem, Physical	None
State	Illinois	IL EPA (CWA)	Chem, Phys	None
		IL DNR	Bio	Fish
	Iowa	IA DNR (CWA)	None	N/A
	Minnesota	MN PCA (CWA)	Bio, Chem, Phys	Fish, Mac
		MN DNR	Bio	Fish
	Missouri	MO DNR (CWA)	None	N/A
		MO DoC	Bio	Fish
	Wisconsin	WI DNR (CWA)	Bio, Chem, Phys	Fish
Local	Twin Cities Metropolitan Council	MCES	Bio, Chem, Phys	Mac

* Bio: Biological communities; Chem: Chemical parameters; Phys: Physical conditions.
 ** Mac: Macroinvertebrates; Ppt: Periphyton; Pkt: Phytoplankton; SAV: Submersed Aquatic Vegetation.
 *** EMAP-GRE monitoring was limited to 2004-2006. It is not an ongoing program.

Current UMR Assessments and Listings

Under the CWA, each state must assess the condition of its portion of the UMR. Currently, states' UMR assessments are conducted independently – i.e., there is no unified UMR CWA assessment. The states use their own data and that of other programs to varying degrees in conducting their assessments. The states do, however, use common reaches to organize the interstate UMR into segments for CWA Section 305[b] water quality assessments and Section 303[d] impairment listings. This framework comprises “minimum assessment reaches” for the UMR.

Current UMR CWA impairment listings are predominated by toxic pollutants and “legacy” contaminants and are often inconsistent between bordering states. In addition, the states are limited by the lack of a consistent methodology to translate biological data into an assessment of aquatic life use status. Under current approaches, a minority of UMR assessment reaches (e.g., 4 of 13 in of 2008) are listed for aquatic life designated use impairment.

Identification of Preferred Methods for UMR CWA Bioassessment

A central goal of this project was to review existing biological monitoring programs (see table above) and determine if any could help support a future, biology-driven UMR CWA aquatic life use assessment. These programs were therefore evaluated against the following key elements for a CWA bioassessment program with systemwide applicability:

1. collects biological data on the UMR main channel;
2. utilizes methodologies that produce assessments sufficient in their rigor to support the needs of multiple management programs;
3. has results applicable to the entire UMR main channel, or a large portion thereof; and,
4. overall, in terms of methods, logistics, indicators, and design, forms the basis for a sustained UMR main channel bioassessment.

Two programs emerged as the clearest candidates to potentially support UMR CWA biological assessment. These are the US EPA's Environmental Monitoring and Assessment Program-Great Rivers Ecosystems (EMAP-GRE) and the US Army Corps of Engineers' Environmental Management Program Long Term Resource Monitoring Program (LTRMP). As such, both were examined greater detail, including the application of a Critical Technical Elements evaluation process. Based on its examination of the two programs, MBI concluded that, while LTRMP incorporates many of the desirable elements of a CWA bioassessment program, the EMAP-GRE approach is preferred because it provides systemwide data, has developed fish and macroinvertebrate indices, and, most importantly, has a sampling site protocol that allows for assessment to be done at multiple scales, from site-based to systemwide.

MBI thus identified EMAP-GRE as the preferred approach for conducting UMR CWA aquatic life use assessment among existing programs. This recommendation responds to the project goal of identifying existing tools that can support a biologically based assessment. However, EMAP-GRE was a research and development effort with no plans for future sampling. This means that sustaining anything beyond a one-time assessment requires a strategy for conducting future UMR monitoring and assessment.

Assemblage and Index Recommendations

Consistency in the application of biological indicator assemblages and indices is critical to valid assessment of the UMR main channel. MBI recommends the following as preferred assemblages and indices (details and origins of each index are discussed in the Guidance Document):

Upper Impounded Reach (Pools 1-13):

- Impounded Great Rivers Fish Index (GRFIn)
- *Ad hoc* macroinvertebrate index – a modification of the Great Rivers Macroinvertebrate Index (GRMIn)
- Submersed Macrophyte Index (SMI)

Lower Impounded Reach (Pool 14-Missouri River):

- Impounded GRFIn
- *Ad hoc* macroinvertebrate index

Open River (Missouri River to Ohio River):

- Missouri River GRFIn
- Missouri River GRMIn

These recommendations are based on the performance of each index as evaluated in the project's Bioassessment Thresholds and Biological Condition Gradient reports.

The essential finding here is that these aquatic assemblages should be part of a long term UMR CWA monitoring strategy. MBI recommends that the states move forward with these assemblages and indices now, as they provide adequate tools to conduct a meaningful UMR CWA assessment, recognizing that future adjustments and improvements are to be expected. In fact, improvements in the indices will be powered by the aggregation of long term datasets resulting from the ongoing monitoring of these assemblages.

Biocriteria Thresholds

Along with identifying methods, assemblages, and indices, this project sought to examine potential CWA biological assessment thresholds. The project's analyses demonstrated that currently available databases and indices allow for the selection of meaningful, attainable CWA baseline biological thresholds for the UMR main channel. Moreover, fundamentally different methods of derivation yielded similar thresholds in terms of index scores, indicating that the process employed was robust.

Additionally, preliminary BCG analyses aided in better visualizing thresholds in an ecological sense, lending confidence to threshold identification. A more formal BCG analysis could help refine threshold selection even further, perhaps also establishing additional tiers, and is recommended as a future project.

Implications of Adopting Biological Assessment

Based on its preliminary biological thresholds work, MBI has identified several likely consequences of applying biological assessment to the UMR. These include:

1. Prior impairment determinations based on chemical/physical parameters will change.
2. The quantity of impairment (i.e., lineal miles of mainstem impaired) will increase.
3. A sharper definition of causes and sources of impairment will be accomplished.
4. Refined spatial definitions of impairments may lead to changes in main channel reporting reaches and lateral distinctions in the future.

5. Application of “tiered aquatic life uses (TALU)” concepts is feasible and may lead to refinements in impairment determinations.

Options for Sustained UMR Bioassessment

None of the programs that currently collect biological data on the UMR provides a seamless substitute for the preferred EMAP-GRE approach. Therefore, if the states choose to move forward with a sustained effort, they will need to consider if and how to work from existing programs in implementing a future UMR biological assessment, especially if a new “EMAP-GRE like” program is not forthcoming.

Ideally a single entity would execute and manage a future UMR bioassessment. The rationale for this approach includes addressing concerns that naturally accompany a multiple entity approach. These concerns include the obvious standardization challenges, but also study design, data management, and data analysis issues. MBI recommends that the single entity option be considered in monitoring strategy development, even if a multiple entity approach is perhaps a more realistic outcome. Moreover, a monitoring strategy blueprint for all aspects of a standardized main channel bioassessment is necessary whether a single entity or multiple entities actually conduct the work.

UMR CWA Monitoring Design Recommendations

While an EMAP-GRE style of monitoring design is recommended, the following details should also be considered in a UMR CWA monitoring strategy:

1. A pollution survey design that is consistently more spatially intensive than the EMAP-GRE design is recommended. Some UMR assessment reaches had as few as 3 sampling sites under the current EMAP-GRE sampling design, which is insufficient for site scale and assessment reach scale assessment.
2. Chemical/physical data should be used as stress and exposure indicators to help explain biological results. While some chemical parameters could be identified as proximate stressors using existing EMAP-GRE data, it was weak from a frequency perspective in supporting stressor identification. As such, the

integration of more complete chemical/physical monitoring is recommended as part of a UMR CWA monitoring strategy.

3. A habitat assessment protocol should be implemented that generates an assessment of the comparative quality of UMR main channel habitat at the site level. Such a tool will be needed as part of a long term monitoring and assessment strategy.
4. A UMR main channel strategy should include a rotating approach to systemic monitoring. It is reasonable to assume that multiple years will be required to sample the entire UMR main channel. Each rotation cycle should be five years or less in duration.

Summary

In summary, MBI recommends that the states take the information provided in this guidance to:

1. develop a UMR-wide CWA monitoring strategy incorporating biological indicators;
2. include an intensive, longitudinal pollution survey design as the core of the strategy for bioassessment;
3. examine programmatic options for implementing such a strategy, identifying the costs and technical pros and cons of each option;
4. use the biological assemblage, biological index, and biocriteria threshold recommendations made here as the basis for an initial biological assessment of the UMR main channel, with future assessments based on a new monitoring program; and,
5. develop and utilize a data management system that is easy to use and access, and that delivers data in a portable and relational format.

For More Information

For more information, please see the UMRBA web site (www.umrba.org) or contact Chris Yoder at MBI (614-457-6000, yoder@rrohio.com) or Dave Hokanson at UMRBA (651-224-2880, dhokanson@umrba.org).

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