

The Biological Assessment Program Review: Assessing Level of Technical Rigor to Support Water Quality Management

Introduction and Background

Biological assessments have been a component of state, territorial and tribal (hereafter referred to as “state”) water quality monitoring and assessment programs for nearly four decades. Today, states employ biological assessments as a primary measure of Clean Water Act (CWA) goal attainment for aquatic life.

States have used biological assessments and criteria to more accurately define their designated aquatic life uses, develop biological criteria, inform stressor identification, and improve both the identification and characterization of impaired waters (US EPA 2011, 2013 and 2016). At the same time state water quality agencies face challenges to ensure that the best available science serves as the backbone of their monitoring and assessment programs.

The degree of confidence with which biological assessment information can be used to support an array of water quality management programs and functions depends to a considerable degree on the level of technical rigor. The state program review process provides an opportunity for states and tribes to evaluate the technical rigor of their biological assessment program and determine how they could better support all their CWA programs (U.S. EPA 2013).

The state program review process can help states identify the technical strengths and limitation of their biological assessment program and use it to develop a plan for improvement and maintenance. As such, the process provides detailed guidelines and milestones by which state agencies can evaluate and track progress in the development and implementation of their biological assessment programs.

Key Questions to be Answered

- What are strengths of the technical program?
- What are the limitations of technical program?
- How to determine priorities and allocate resources to further develop the technical capabilities of an existing program?
- How can biological assessments be used to more accurately define designated aquatic life uses and develop numeric biological criteria?
- How can bioassessments be used to more fully support water quality management programs?

What Does a Biological Assessment Program Review Entail?

The biological assessment program review includes an evaluation of the critical technical elements, or components, of a biological monitoring and assessment program and provides a forum for agency cross-program discussions. The intent is to provide an opportunity for state program managers and staff to discuss how biological assessments can better support their management programs. These discussions can reveal opportunities for program improvement and coordination that will foster a better understanding about how biological assessments can be used. An improved understanding will help answer the “so what” question for why an agency would allocate staff and resources for making technical improvements.

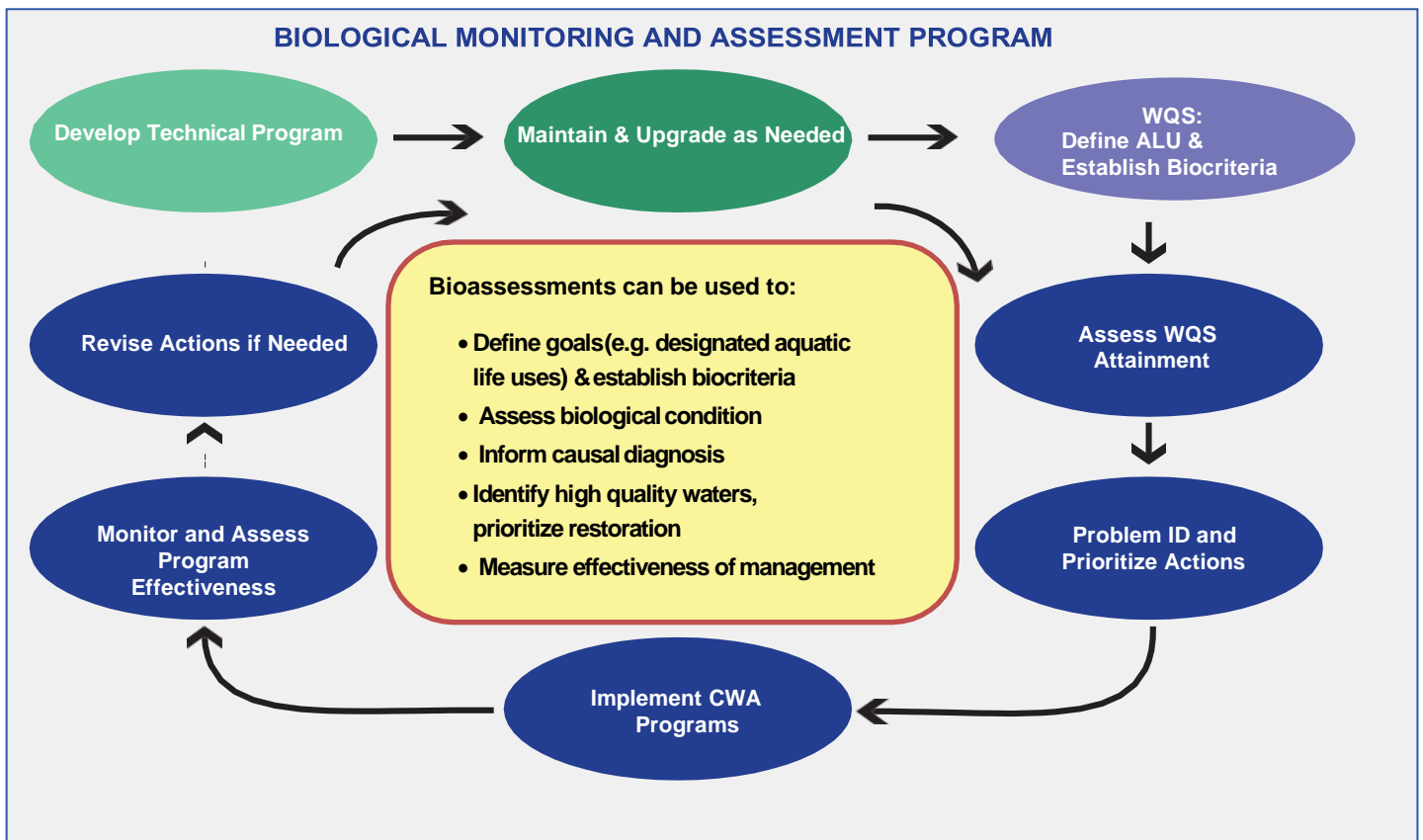


Figure 1. Water quality management program support is enhanced with rigorous biological assessment programs.

The goal of the review is to document the technical strengths of the biological assessment program and determine the needs for developing a more robust program. The highest level of technical development can be thought of as a well-equipped toolbox consisting of methods, monitoring designs, and analytical techniques that provide support for an array of water quality management information needs. An end goal of the evaluation is a blueprint for technical program development to enhance the use of biological assessments in water quality management programs (Figure 1). Such a plan will identify incremental steps for technical and program development based on the strengths and gaps identified by the review.

The guiding principles of the program review are intended to help state monitoring and assessment programs achieve levels of standardized, rigor, reliability and reproducibility that are reasonably attainable under current technology and reasonable funding. This will, in turn, produce a more accurate, comprehensive, and cost-effective monitoring and assessment program capable of meeting the broad goal of supporting all relevant water quality management programs. The program review process adheres to the following principles:

Accuracy – biological assessments should produce sufficiently accurate delineations of condition so that assessment errors are minimized;

Comparability – bioassessment programs that utilize different technical approaches should produce comparable assessments in terms of biological condition ratings, detection of impairments, and diagnostic properties;

Comprehensiveness – biological assessments should be integrated with chemical, physical, and other stressor or exposure indicators, each used in their respective indicator roles, to demonstrate the relationship between human disturbances and biological response; and,

Cost-effectiveness – cost-effective used here means that the benefits of having a rigorous and reliable biological assessment program to support making better management decisions outweighs the intrinsic costs of program development and implementation.

Technical Elements Used in a Program Review

The level of technical rigor is revealed by evaluating 13 critical technical elements that provide the foundation of biological assessment design, data collection and compilation, and analysis and interpretation (Table 1). Design includes temporal and spatial considerations, accounting for natural variability, and determining reference condition. Data collection and compilation includes field and laboratory protocols, technical proficiency and qualifications, and data management. Analysis and interpretation include data analysis, causal assessment, and review procedures.

The overall level of program rigor is based on individually scoring the 13 critical technical elements based on narrative descriptions of four levels of rigor for each element. Each of the 13 critical technical elements receive a score based the current state of technical development. The element scores are then summed for an overall program score with higher scores reflecting higher levels of technical development. Four levels are possible with Level 4 being the highest and descending to Level 1 as the lowest. These levels of rigor reflect both the technical development and capacity of a biological assessment program to provide increased support for water quality management programs on a routine basis. The evaluation is also used to identify and characterize any gaps in technical development that currently impede this goal and suggesting steps for making improvements.

	Technical Element	Description
Biological Assessment Design	Index Period	A consistent time frame for sampling the assemblage to characterize and account for temporal variability.
	Spatial Sampling Design	Representative and adequate spatial array of sampling sites to support valid inferences of information about the extent and severity of pollution and status both locally and aggregated to larger areas (e.g., watersheds, river and stream reaches, geographic region) and for supporting water quality standards (WQS) and multiple CWA management programs.
	Natural Variability	Characterizing and accounting for the inherent make-up in biological assemblages in response to broad scale natural factors (geology, climactic, geographical).
	Reference Site Selection	Abiotic factors are primarily used to select sites that are least impacted, or ideally, minimally affected by anthropogenic stressors.
	Reference Condition	Characterization of benchmark conditions among reference sites to establish defensible and attainable thresholds such as numerical biocriteria and for chemical/physical stressors.
Data Collection and Compilation	Taxa and Taxonomic Resolution	Type and number of biological assemblages that are fully assessed and taxonomic resolution (e.g., family, genus, or species).
	Sample Collection	Protocols used to collect representative data in a water body including procedures used to collect and preserve the samples (e.g., equipment, effort).
	Sample Processing	Methods used to identify, and count organisms collected from a water body, including the specific protocols used to identify organisms, subsampling, the training of personnel, and the methods used to perform quality assurance/quality control (QA/QC) checks of the data.
	Data Management	Systems used by a program to store, access, and analyze collected data.
Analysis and Interpretation	Ecological Attributes	Measurable attributes of a biological assemblage that are representative of biological integrity and which provide the basis for developing biological criteria.
	Discriminatory Capacity	Capability of the biological indices, metrics, and models to distinguish in increments of biological condition along the Biological Condition Gradient (BCG).
	Stressor Association	Relationship between measures of stressors, sources, and biological assemblage responses sufficient to support causal diagnosis and to develop quantitative stress-response relationships and thresholds.
	Professional Review	Level to which agency data, methods, and procedures are reviewed by others both within and outside the agency.

Table 1. Descriptions of the critical technical elements organized by three principal foundational categories

As the level of technical development advances, biological assessment information can be used to support an increased number of water quality management programs on a routine basis. Over the past twenty years, as state programs have developed more robust programs, the capability to more broadly support water quality management programs has increased (Table 2). For example, Level 2 programs can typically support statewide 305(b) reporting and 303(d) listing using single attainment thresholds. Whereas, in addition to supporting 305(b)/303(d), Level 3 and 4 programs are able to more accurately characterize and set thresholds along a biological condition gradient (e.g. excellent, good, fair, poor) rather than a single “one size fits all” threshold. Level 4 programs routinely pair the collection of biological data for two or more assemblages with chemical and physical parameters to better identify priority stressors and inform causal analysis. These technical strengths produce a program that can identify high quality waters, set attainable targets for degraded waters, prioritize restoration and protection, and track the effectiveness of the management programs.

Table 2. An increase in the technical rigor of a state’s biological monitoring program has corresponded with increased use of the data and information to more broadly support water quality management programs.

CWA Program	Specific Support Functions	Level of Rigor			
		1	2	3	4
Reporting & Listing (305b/303d)	Status – delineating impairments	○	●	●	●
	Trends – statewide scope, long term	—	○	●	●
Water Quality Standards (WQS)	Refined Uses (TALUs)	—	—	◐	●
	Use Attainability Analyses (UAA)	—	—	◐	●
	Refined Water Quality Effects Thresholds	—	—	○	●
	Antidegradation	—	—	○	●
	Site-specific Criteria	—	—	○	●
TMDLs	TMDL Development & Effectiveness	—	—	◐	●
	Advanced TMDLs (non-pollutants)	—	—	—	●
	Causal Analysis & Diagnosis	—	—	◐	●
Watersheds/319	Choosing BMPs	—	○	◐	●
	Measuring BMP Effectiveness	—	○	◐	●
	Habitat Assessment & Restoration	—	—	○	●
	Identify High Quality Waters	—	—	◐	●
	Integrated Planning & Prioritization	—	—	—	●
NPDES/Other Permitting	WQBELs	—	—	◐	●
	CSO/SSO, Stormwater Assessment	—	—	◐	●
	Severity & Extent of Impairments	—	—	◐	●
	WET Limits & TIE/TRE	—	—	◐	●
	Facility Compliance Evaluation	—	○	◐	●
	401 Certification (404 Dredge & Fill)	—	—	◐	●

● routine ◐ occasional ○ informal/incidental — none

Which Waterbody Types Can Be Evaluated?

All the program reviews conducted to date have focused primarily on rivers and streams. However, some of program reviews included wetlands, lakes, and estuarine waterbody types. Some adjustments to the critical technical elements matrix were necessary to accommodate the different aquatic waterbody types but the process and checklist were fully transferable.

Who Are the Primary Participants?

A review should include:

- State agency program managers and staff;
- EPA regional staff; and,
- An independent facilitator with experience in the design and implementation of state biological assessment and biological criteria programs.

The program review consists of an on-site visit at the state agency lasting 2-3 days. The state, their EPA partners, and the independent facilitator jointly evaluate how biological assessment information is currently used to support water quality management programs and consider the potential for future applications made possible by a strengthened technical program. State agency representation can also involve all relevant water quality management programs, but the monitoring and assessment and water quality standards (WQS) programs should be included at a minimum. Follow-up reviews have been periodically conducted and used to track progress and provide technical assistance. All reviews are done at the discretion of a state.

How Are the Review Results Provided to The State?

Following the review, the independent facilitator prepares a detailed technical memorandum that describes the program's technical strengths, identifies the technical gaps that were revealed by the evaluation and provides specific recommendations to the state for making improvement to its bioassessment program. This information can be used by the state to efficiently target resources to incrementally strength the bioassessment program and, in turn, better support water quality management programs.

Interested in More Information?

The details of the program review process are described in more detail in the document *Biological Assessment Program Review: Assessing Level of Technical Rigor to Support Water Quality Management* (U.S. EPA 2013). Please contact your EPA Regional Biological Monitoring or Biological Criteria Coordinator or Susan Jackson, Health and Ecological Criteria Division, Office of Water (Mail Code 4304T), Environmental Protection Agency, 1200 Pennsylvania Avenue NW., Washington, DC 20460 or by email at jackson.susank@epa.gov.

References:

U.S. EPA. 2011. *A Primer on Using Biological Assessments to Support Water Quality Management*. EPA 810-R-11-01. Office of Science and Technology, Washington, DC 20460.

U.S. EPA. 2013. *Biological Assessment Program Review: Assessing Level of Technical Rigor to Support Water Quality Management*. EPA 820-R-13-001. Office of Science and Technology, Washington, DC 20460.

U.S. EPA. 2016. *A Practitioner's Guide to the Biological Condition Gradient: A Framework to Describe Incremental Change in Aquatic Ecosystems*. EPA 842-R-16-001. Office of Science and Technology, Washington, DC 20460.