

Monitoring Monday – Let's look at biological integrity.

Join us each Monday as the Clean Water Team shares resources on water quality monitoring. Today we will take a look at biological integrity.

What is biological integrity?

Biological integrity has been defined as "The ability to support and maintain a balanced, integrated adaptive assemblage of organisms having species composition, diversity, and functional organization comparable to that of natural habitat of the region". As a result of evolution, each organism is adapted to the environmental conditions in its native biogeographic region. An environment that supports an assemblage of organisms similar to that produced by long-term evolutionary processes has high biological integrity. Changes of the environmental condition resulting from human activities cause a decline in biological integrity and can make the environment uninhabitable for appropriate organisms.

A biological integrity approach consists of four steps:

- 1) defining biological condition in a minimally disturbed area - what the natural condition in the area should be,
- 2) defining biological attributes that change along the gradient of human influence,
- 3) associating those changes with specific human impacts, and
- 4) identifying management practices for improving biological integrity. The IBI can convey broad biological information expressed both numerically and narratively.

Biological monitoring is the first step in protecting biological integrity in waters. Biological Integrity can be defined as "a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitat of the region."

A biota's condition as revealed through biological monitoring offers the most comprehensive indication of ecological risks in a particular place.

Bioassessment is a cost-effective biological monitoring tool that utilizes measures of the stream's benthic macroinvertebrate (BMI) community and its physical/habitat structure. Because they are ubiquitous and sensitive in varying degrees to anthropogenic pollutants and other stressors, BMIs can provide considerable information regarding the biological condition of water bodies.

Together, biological, and physical assessments integrate the effects of water quality (and any changes) over time, are sensitive to multiple aspects of water and habitat quality, and provide the public with more familiar expressions of ecological health). The additive or synergistic effects of multiple stressors, including the cumulative effects of sub-lethal doses of toxins, are reflected in changes in the community composition and structure in the stream benthos.

Metrics are measures of changes in biological attributes that respond predictably to disturbance, pollutants, or other stressors. Metrics are chosen on the basis of whether they reflect specific and consistent biological responses to human activities. Ideal metrics are also relatively easy to measure and interpret, are sensitive to a range of biological stresses, and can discriminate between human caused changes and the background “noise” of natural variation. In a multimetric approach to biological assessment, the metrics that exhibit the strongest response to human caused changes in the stream are combined into a single score, such as an Index of Biotic Integrity (IBI) or the California Stream Condition Index (CSCI).

Because it focuses on the living organisms whose very existence represents the integration of conditions around them, biological evaluations expressed as an IBI or its equivalent, can diagnose chemical, physical, and biological impacts as well as their cumulative effects on beneficial uses.

Bioassessment can serve many kinds of environmental and regulatory programs. Because it focuses on what is at risk, bioassessment analysis is a powerful diagnostic tool and an essential measurement of beneficial use attainment and protection. As such, it is less likely to under protect aquatic systems or to waste resources (Karr and Chu 1999, Davis and Simon 1995)

Bioassessment Primer

www.waterboards.ca.gov/water_issues/programs/swamp/docs/cwt/guidance/352.pdf

Ecological Perspective on Water Quality Goals

<https://link.springer.com/article/10.1007/BF01866609>

Biological Diversity and Biological Integrity: Current Concerns for Lakes and Streams (USEPA)

https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NHEERL&dirEntryId=36367

Biostimulation, Cyanotoxins, and Biological Condition Provisions

www.waterboards.ca.gov/water_issues/programs/biostimulatory_substances_biointegrity/index.html

SWAMP – Bioassessment

www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/

- [California Stream Condition Index \(CSCI\)](#)
- [Bugs, Fish and Algae, oh my...California's Bioassessment Program: Twenty years of bioassessment in California \(Video\)](#)

2022 California Aquatic Bioassessment Workgroup (CABW) and the California Chapter of the Society of Freshwater Science (Cal-SFS) Meeting

www.eventbrite.com/e/2022-cabw-and-cal-sfs-meeting-tickets-354891338547

- [2021 California Aquatic Bioassessment Workgroup Meeting \(Videos\)](#)

- [California Aquatic Bioassessment Workgroup \(CABW\) Annual Meeting - Oct 13, 2020](#) (Video)
- [California Aquatic Bioassessment Workgroup Meeting October 14, 2020](#) (Video)

Applications of Indices of Biotic Integrity to California Streams and Watersheds

www.taylorfrancis.com/chapters/edit/10.1201/9781003068013-17/applications-indices-biotic-integrity-california-streams-watersheds-peter-moyle-michael-marchetti

Assessing Biological Integrity in Running Waters: A Method and Its Rationale

<https://sempub.epa.gov/work/01/554353.pdf>

Biological Integrity: A Long-Neglected Aspect of Water Resource Management

www.jstor.org/stable/1941848

Biological Integrity Versus Biological Diversity as Policy Directives: Protecting Biotic Resources

www.researchgate.net/publication/291265850_Biological_Integrity_Versus_Biological_Diversity_as_Policy_Directives_Protecting_Biotic_Resources

Fresh Waters Flowing ([Video Intro](#))

Fresh Waters Flowing explores the relationship of salmon, people, and watershed habitat.

<https://www.cbr.washington.edu/salmonweb/pubs/index.html#video>

Indices of Biotic Integrity

www.sccwrp.org/about/research-areas/bioassessment/indices-of-biotic-integrity/

Lake Tahoe Watershed Assessment: Chapter Five - Biological Integrity

www.fs.fed.us/psw/publications/documents/psw_gtr175/psw_gtr175_ch5.pdf

Related Clean Water Team Resources:

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_guidance.html#30

www.waterboards.ca.gov/water_issues/programs/swamp/cwt_guidance.html#40

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