BIOASSESSMENT OVERVIEW

General Definition

Bioassessment refers to a process for evaluating the ecological integrity of both terrestrial and aquatic environments by measuring characteristics of organisms or organism assemblages that inhabit those environments. For aquatic environments, bioassessment refers to the assessment of ecological integrity of a waterbody by measuring attributes of the assemblage of organisms inhabiting the waterbody. In conjunction with biological measurements, bioassessment of aquatic environments usually includes measurements of instream and riparian zone physical habitat constituents. Common assemblages of aquatic organisms used for bioassessment include fishes, macroinvertebrates, and algae. However, population characteristics of single species ("sentinel"), are also used as biological indicators of ecological integrity. BioAssessment Services specializes in macroinvertebrate-based bioassessment, and predominately the use of benthic (bottom dwelling) macroinvertebrates to assess waterbody condition.

Rationale

Why use benthic macroinvertebrate (BMI) assemblages for assessing aquatic ecological integrity? The BMI assemblage is an essential component of the food web in aquatic habitats. This group of bottom dwelling organisms cycle nutrients in their aquatic environment by feeding on algae, organic detritus and by preying on a wide range of small organisms. BMIs are an important food resource for fishes, amphibians, reptiles, birds and mammals. Because of BMI abundance, taxonomic diversity, residence time, and range of response to changes in their aquatic environment, they are commonly the resident biota used to monitor the quality of water resources throughout the United States (Davis *et al*. 1996). The advantages of using BMIs as indicators of water and habitat quality have been supported by many investigators, such as Hutchinson (1993), Karr and Chu (1999), Rosenburg and Resh (1993), and Ziglio *et al*. (2006).

Limitations

While bioassessment has proven to be useful for identifying gradients of ecological condition, it is not yet developed enough to consistently isolate factors that influence the gradients. This limitation is evident with respect to separating effects of natural gradients, such as those associated with elevation change, from effects of anthropogenic gradients, such as extent of impervious surface. Establishing reference sites across a broad range of natural gradients is one way to improve the discrimination of factors that influence biotic assemblages. However, the establishment of reference sites across large geographic areas is incomplete, and perhaps not feasible in heavily populated areas. Consequently, the discriminating power of bioassessment in California is currently limited by the extent and quality of reference sites.

Spatial Scales

Bioassessment is performed on several spatial scales. At the smallest scale, point source perturbations such as discharge from a pipe are evaluated. On a larger scale,

non-point source perturbations are evaluated such as sediment derived from multiple sources of differing magnitude within a drainage. Broader, regional scale bioassessments are ongoing in California and several projects have yielded indices of biotic integrity for large geographic regions such as southern coastal California (Ode *et al*. 2005). These assessment strategies require standardized procedures and the incorporation of controls or references to compare with the affected or treatment groups.

Sampling Strategies

Bioassessment may be restricted to one assessment to evaluate waterbody condition at one point in time, or it may be conducted at regular intervals to evaluate change through time (biomonitoring). Biomonitoring may reveal trends in water body condition as a result of many factors such as changes in water-year types, pollution abatement practices, or habitat restoration activities. In addition, bioassessment may be conducted before and after an expected perturbation to evaluate its effect. For these assessment strategies to be successful, standardization of sampling and sample processing is crucial. Furthermore, standardization saves time and cost by facilitating the integration of historic data sets derived from standardized procedures. Consequently, maintaining long-term, standardized sampling and sample processing procedures through broad geographic regions greatly enhances the power of bioassessment as a tool for evaluating aquatic ecological condition.

Literature Cited

Davis, W.S., B.D. Syder, J.B. Stribling and C. Stoughton. 1996. Summary of State Biological Assessment Program for Streams and Wadeable Rivers. EPA 230-R-96-007. U.S. Environmental Protection Agency; Office of Policy, Planning and Evaluation, Washington D.C.

Hutchinson, G. E. 1993. A Treatise on Limnology. Vol. IV, The Zoobenthos. (Ed.) Y.H. Edmondson. John Wiley & Sons, Inc., Toronto, 944p.

Karr, J.R. and E.W. Chu. 1999. Restoring Life in Running Waters. Island Press, Covelo, CA.

Ode P.R., A.C. Rehn, J.T. May. 2005. A quantitative tool for assessing the ecological condition of streams in southern coastal California. Environmental Management 35: 493–504.

Rosenburg, D.M. and V.H. Resh (eds). 1993. Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman and Hall, New York.

Ziglio, G., M. Siligardi, and G. Flaim (eds). 2006. Biological monitoring of rivers: applications and perspectives. John Wiley & Sons, New York. 469 pp.