

Complying With the Clean Water Act Using Aquatic Biota to Set Water Quality Standards (Newsletter)*

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The basis for water quality is decades out of date, given our current understanding of environmental data and availability of recently developed statistical models. The use of a single maximum concentration limit (MCL) for individual chemical elements does not reflect natural ecosystem function nor provide accurate indications of whether regulated industrial activities adversely impact the specific designated beneficial uses of surface or ground waters at specific locations. Water is a complex mixture of compounds, not individual ions, and concentrations vary with temperature, pH, binding and release with inorganic and organic substrata, and other factors. A sample of water represents a snapshot at a specific time and place. This is why aquatic ecologists have established data collection standards to minimize variability when measuring physical and chemical parameters of flowing and standing waters.

Aquatic biota are much more reliable indicators of ambient water quality than are concentrations of chemical elements. The EPA considers aquatic life to be the highest and best use of water (that is, the use most sensitive to anthropogenic disturbance). Aquatic biota exist with the abiotic physical and chemical environments to form natural ecosystems.

Natural ecosystems are highly complex; we cannot have complete knowledge of their variability and interactions among all components. About 50 years ago, when environmental laws began to be created, ecologists were moving from qualitative descriptions of ecosystems, communities, and populations to quantitative measures of their dynamics. Also, appropriate statistical models did not exist, and computers were not as widely (or easily) used as they are today. To implement these statutes regulators had to assess and compare natural ecosystems in attempts to determine anthropogenic effects. The approach used then was to create methods producing a single numerical value assumed to summarize ecosystem quality and separate "good" from "bad" conditions. These species diversity and biotic integrity indices still are used today. And they still fail to describe ecosystem complexity, to quantify inherent natural variability, and to separate natural and anthropogenic changes to these systems.

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These failings are overcome by applying appropriate, modern statistical models to biotic data.

An important benefit of robust statistical analyses of ecosystems is that they integrate components of each drainage basin and its stream network. This integration provides insights that regulators and other stakeholders can use to make informed decisions. These statistical analyses do not produce a dichotomous decision point (less than this number is good, greater than this number is bad), but allow the use of Best Professional Judgment and adjusted as more data and knowledge become available.

The monograph describes application of these ideas and protocols to several stream systems that drain the operational areas of the Jerritt Canyon Mine in the southern Independence Mountains, Elko County, Nevada. Each basin is described and characterized individually because they all differ. Inter-basin analyses could be accomplished with more data and the results would explain why the basins differ. The data available for each stream range from 4 to 8 years. Some statistical models could not be used because too few data were available. This conservative behavior discourages decision-making on weak or insufficient data. Over all the stream networks there was moderate to high variability in functional feeding group component ratios and explanatory variables. Any anthropogenic influences were within the variability range and did not modify biotic compositions in any distinctive way.

The ideas, models, and analyses described in this document can be usefully applied in any drainage with suitable data; their power for regulators and the regulated public justifies the efforts and costs for obtaining such data for baseline and permit compliance monitoring.

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