

## **Session I5: Monitoring for Nutrient Impacts and Criteria Development**

Room C123  
10:00 – 11:30 am

**0017**  
**I5-1**

### **Using Multiple Lines of Evidence to Assess Biostimulatory Effects in Central Coastal California Surface Waters**

Karen Worcester<sup>1</sup> and Dave Paradies<sup>2</sup>

<sup>1</sup>California Central Coast Regional Water Quality Control Board, San Luis Obispo, Calif., USA, <sup>2</sup>Bay Foundation of Morro Bay, Morro Bay, Calif., USA

This paper describes an approach for interpreting narrative nutrient objectives using multiple lines of evidence, including state and federal standards, guideline values from the literature, monitoring data, and modeled estimates of potential algal growth and resultant oxygen deficits. The resulting numeric endpoints can be used for water quality assessments and to support assessment decisions for Clean Water Act Sections 303(d) and 305(b) reporting.

We identified a pool of sites from the California Central Coast Ambient Monitoring Program dataset that have always met oxygen objectives, and from this dataset, identified an upper range for dissolved oxygen concentration of 13 milligrams per liter (mg/L), over which site oxygen concentrations rarely or never fell. We identified a subset of these sites as “reference”, that showed no signs of eutrophication, including depleted or elevated oxygen levels, water column chlorophyll *a* exceeding 15 micrograms per liter (µg/L) or observed floating algal cover exceeding 50%. We examined nutrient characteristics of reference data to identify a proposed screening criterion of 1.0 mg/L nitrate as nitrogen (mg/L NO<sub>3</sub>-N) to protect aquatic life. This number represents the 95th percentile of the reference data set. We then used the California Benthic Biomass Tool (Tetrattech, 2007), or “Benthic Biomass Tool”, to evaluate individual monitoring sites in terms of predicted oxygen deficits, maximum benthic algal biomass and benthic chlorophyll *a* concentrations. These modeled outputs can be evaluated against the “presumed impaired” thresholds identified in the “Technical Approach to develop Nutrient Numeric Endpoints for California” (Creager, 2006), to characterize the risk of eutrophication associated with specific conditions at a given site or water body.

Based on this analysis, we have designated water bodies as impaired for aquatic life use when nitrate concentrations exceed 1.0 mg/L NO<sub>3</sub>-N and there is additional evidence of eutrophication, such as depressed or supersaturated dissolved oxygen concentrations, pH over 9.5, floating algal mats over 50%, water column chlorophyll *a* concentrations over 15 µg/L, predicted oxygen deficits over 1.25 mg/L, and predicted benthic algal biomass or predicted benthic chlorophyll over levels recommended by the “Technical Approach to develop Nutrient Numeric Endpoints for California.”

**0043**  
**I5-2**

### **Adapting a Biological and Water Quality Monitoring Program to Supply Information Required for Implementing Numeric Nutrient Criteria**

Robert Miltner

*Ohio Environmental Protection Agency, Groveport, Oh., USA*

Numeric water quality standards for nutrients in running waters are novel, and their programmatic implementation presents significant challenges owing to the largely indirect and often tenuous relationship between nutrient concentrations, and manifestations of enrichment. Perhaps the most obvious, and therefore easily remedied, challenge exists for 305b/303d listings and determination of reasonable potential. Quite simply, in addition to comparing measured nutrient concentrations against numeric standards, measures of response variables such as chlorophyll *a* and dissolved oxygen are required to position a waterbody along a gradient of nutrient enrichment prior to making listing decisions, or determining reasonable potential. Ohio EPA is now including measures of water column and benthic chlorophyll *a*, and hourly dissolved oxygen monitoring in its routine biological and water quality surveys to support incipient numeric water quality standards for total phosphorus and inorganic nitrogen. These measures, along with biological index scores for fish and macroinvertebrates are rarefied into a single index, called the Trophic Index Criterion, to position a waterbody along the enrichment gradient. Recent surveys of the Great and Little Miami Rivers illustrate how the measures are incorporated into monitoring, and how the results help inform decisions.

0462  
I5-3

### **A Biological Condition Gradient Approach for Using Diatoms to Assess Nutrient Conditions: New Jersey Streams**

Donald Charles<sup>1</sup>, Andrew Tuccillo<sup>1</sup> and Thomas Belton<sup>2</sup>

<sup>1</sup>Academy of Natural Sciences, Patrick Center for Environmental Research, Philadelphia, Pa., USA, <sup>2</sup>New Jersey Dept. of Environmental Protection, Office of Science, Trenton, N.J., USA

We used assemblages of diatom algae and the Biological Condition Gradient approach to help establish nutrient criteria options for New Jersey streams. Excess nutrients are a major water quality problem in many states. Our research was based on previous studies by Ponader et al., who developed diatom based total P and total N inference models and indices for NJ. They used a calibration set of 129 water and diatom samples from 77 streams in the ridge and valley, northern highlands, Piedmont, and coastal plain ecoregions. We used this dataset to apply the Biological Condition Gradient (BCG) approach (Davies and Jackson 2007) to assign the same 77 sample sites to four categories of ecosystem impairment (representing minor to major change from natural condition). The BCG approach is used by the US Environmental Protection Agency to provide a standard set of biological assessment categories that can be applied to different groups of biota and compared throughout the country. Assignments of sites to BCG categories were based on diatom assemblage composition only (no environmental data were provided) and were made by seven diatomists at an expert-panel workshop. Boundaries between the BCG categories were used to divide sites into excellent, good, fair, or poor ecological condition. We related the Diatom TP and TN indices to BCG category boundaries to specify ranges of index values that distinguish sites with acceptable and unacceptable nutrient conditions. For example, if the NJ DEP uses the boundary between BCG category 4 and 5 to represent unacceptable impairment, then the diatom TP Index should be below a value of 57. This range corresponds with total P concentrations of 50 µg/L and less, compared with the current criterion of 100 µg/L. This approach has the advantage of integrated use of diatom-based nutrient metrics and impairment categories, but requires careful attention to factors influencing ecological relationships such as ecoregion differences, watershed land-use, types of stressors, taxonomy, quantification of diatom autecology, and applicability to agency regulations and procedures.

0572  
I5-4

### **The Use of Structural and Functional Indicators to Develop Numeric Nutrient Criteria for Utah's Wadeable Streams**

Mike Shupryt<sup>1</sup>, Jeff Ostermiller<sup>1</sup> and Michelle Baker<sup>2</sup>

<sup>1</sup>Utah DEQ, Salt Lake City, Ut., USA, <sup>2</sup>Utah State Univ., Logan, Ut., USA

Utah, like many States, is developing scientifically defensible numeric nutrient criteria for surface waters. Except in extreme circumstances, nutrients- Nitrogen (N) and Phosphorous (P)-are not toxic to aquatic biota. As a result, common criteria development analytical methods that have been established for toxic substances are not directly applicable for addressing cultural eutrophication. Changes in biologic community structure-the composition or abundance of native species- are a secondary response to changes in ecosystem processes. Ecosystem processes, by definition, are directly altered from excessive nutrients. Functional measures of these ecosystem processes would bridge the gap between nutrient enrichment and biological integrity. However, such measures must also be practicable, given the resource constraints of state and federal management agencies.

In 2010 the Utah Division of Water Quality (UDWQ) instigated a study to determine the affects of nutrients (nitrogen & phosphorus) on both stream ecosystem structure and function. This project had two principle goals: to improve causal linkages between nutrients and uses, and evaluating the potential of integrating measures of functional processes into routine monitoring programs. We sampled 35 wadeable stream s divided into three different levels of nutrient enrichment; 17 reference sites (low nutrients), 9 sites above POTW discharges (typically moderate nutrients from nonpoint sources) and 9 sites below POTW discharges (high nutrients relative to other sites within Utah). We sampled each site for measures of: physical habitat, biologic condition, water chemistry and ecosystem function. Measures of ecosystem function included: nutrient limitation, whole stream metabolism, organic matter storage and organic matter decomposition rates.

Measures of ecosystem function and structure evaluated in this study have been shown to be sensitive responses to cultural eutrophication in a number of academic studies and are also relatively easy and inexpensive to collect. UDWQ will use these indicators of nutrient enrichment to refine numeric N & P water quality indicators and to better integrate the deleterious influence of these nutrients to effects on aquatic life uses. This multiple lines of evidence approach will provide the scientific underpinnings of Utah's nutrient reduction programs.