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Comparisons of targeted-riffle and reach-wide benthic macroinvertebrate samples: implications for data sharing in stream-condition assessments

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Abstract. Recent comparisons of benthic macroinvertebrate (BMI) sampling protocols have shown that samples collected from different habitat types generally produce consistent stream classifications and assessments. However, these comparisons usually have not included biological endpoints used by monitoring agencies, such as multimetric indices (e.g., benthic index of biotic integrity [B-IBI]) or observed-to-expected (O/E) indices of taxonomic completeness, as target variables, and estimates of method precision are rarely provided. Targeted-riffle (TR) and reach-wide (RW) benthic samples have been collected at thousands of sites across the western USA, but little guidance is available for understanding 1) the extent to which raw data sets can be combined in regional or large-scale analyses, 2) the degree of precision afforded by each method, or 3) the efficacy of cross-application of biological indicators derived from one sample type to the other. To address these issues, we used data from 193 sites in California where the Environmental Monitoring and Assessment Program (EMAP) collected the 2 samples side by side. We also conducted a separate study wherein 3 replicates of each sample type were collected from 15 streams to estimate minimum detectable difference (MDD) as a measure of each method's precision. Metrics calculated from TR and RW samples showed similar dose–response relationships to stressors gradients and similar raw scoring ranges. Biological indices (B-IBI, O/E_0, and O/E_{50}) derived from RW samples were more precise than those derived from TR samples, but precision differences were not substantial. On average, pairwise differences in any index between TR and RW sample types were much less than the MDD associated with either sampling method. We observed a weak but consistent bias toward higher O/E_{50} scores from TR samples than from RW samples at the highest elevations and in the largest watersheds. Broad-scale condition assessments were nearly identical when B-IBI and O/E_0 were used as endpoints, and assessments based on O/E_{50} were only slightly less similar. Our analyses indicate that raw data sets and biological indicators derived from TR and RW samples may be generally interchangeable when used in ambient biomonitoring programs.

Key words: benthic macroinvertebrates, bioassessment, sample habitat, index of biotic integrity, predictive models, EMAP, California.

Benthic macroinvertebrates (BMIs) are the most commonly used organisms in freshwater biomonitoring programs (Bonada et al. 2006). Numerous multimetric indices (e.g., benthic index of biotic integrity [B-IBI]), observed-to-expected (O/E) indices of taxonomic completeness, and various other tools have been developed in many parts of the world, including North America (Klemm et al. 2003, Hawkins 2006), Australia (Simpson and Norris 2000), Europe (Moss et al. 1987, De Pauw et al. 1992), New Zealand (Stark 1993), South Africa (Chutter 1972), and Indonesia (Sudaryanti et al. 2001). These biological indicators aid in the interpretation of complex BMI assemblage data and help classify the ecological condition of test sites relative to regional reference conditions (Hughes 1994).

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