QUANTIFYING VARIABILITY: PATTERNS IN WATER QUALITY AND BIOTA FROM A LONG-TERM, MULTI-STREAM DATASET

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Effective water resources assessment and management requires quantitative information on the variability of ambient and biological conditions in aquatic communities. Although it is understood that natural systems are variable, robust estimates of variation in water quality and biotic endpoints (e.g. community-based structure and function metrics) are rare in US waters; due, in large part, to the need for, but paucity of, consistent, long-term studies. A key objective of National Council for Air and Stream Improvement (NCASI) Aquatic Biology Program is to guide and inform facilities, researchers, and regulators by conducting research that increases the understanding of biota and receiving water responses to effluent exposure. Laboratory studies evaluate biological responses to effluent and effluent constituents while field studies place potential lower-level effects into the context of higher-level, in-stream patterns, and utilizes effluent-biota relationships to develop tools or models that address effluent effect concerns applicable to different mills and/or receiving water scenarios. A cornerstone of this program is the Long-term Receiving Water Study (LTRWS), which is a multi-faceted field and laboratory study designed to evaluate effluent-related responses in short- and long-term laboratory bioassays, in-stream water and habitat quality, and the structure of fish, macroinvertebrates, and periphyton communities. Initiated in 1998 in four pulp and paper mill effluent receiving streams (Codorus Creek, PA; Leaf River, MS; McKenzie and Willamette Rivers, OR), water quality and biota are assessed seasonally at multiple sites upstream and downstream of the discharge to differentiate point source stressor responses from variation that occurs naturally over a stream continuum and to evaluate patterns in the context of seasonal and long term annual variability. Assessment of water quality in key tributary streams provides additional information in explaining main channel water quality patterns. We used this multi-year (n=15), seasonally sampled dataset of water quality and biota from multiple sites (n=5-7) to examine spatial and temporal variation in select endpoints (basic WQ variables, nutrient concentrations; select fish and macroinvertebrate metrics, chlorophyll a). Probability distributions and confidence intervals were used to quantify variation across sites and seasons within streams, and as a basis for exploring how variability estimates are affected by sample size. A subset of endpoints will be presented and differences in patterns across endpoints and streams will be discussed. Study results will help guide the design of monitoring studies in terms of number and frequency of sampling and study duration.

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