Scale-dependent Relevance of Watershed, Valley, and Reach Descriptors to Benthic Indices Across Nested Ecoregions of the Pacific Northwest

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Abstract. Over 300 R/EMAP sites in OR and WA are used to examine the relative explanatory power of watershed, valley, and reach scale descriptors in modeling variation in benthic macroinvertebrate indices. Innovative metrics describing flow regime, geomorphic processes, and hydrologic-distance weighted watershed and valley characteristics are incorporated into multiple regression modeling to predict strategic biological metrics. A nested design of ecoregions is employed to evaluate the influence of geographic scale and environmental heterogeneity on the explanatory power of individual and combined scales. Study results demonstrate differences in the explanatory power associated with single-scale and multi-scale models as environmental heterogeneity is varied. Models explaining the greatest variability in biological indices result from multi-scale combinations of physical descriptors. Results also indicate that substantial variation in benthic macroinvertebrate response can be explained with process-based watershed and valley scale metrics derived exclusively from common geospatial data. This study outlines a general framework for identifying key processes driving macroinvertebrate assemblages across a range of scales and establishing the geographic extent at which various levels of physical description best explain biological variability. Such information can guide process-based stratification to avoid spurious comparison of dissimilar stream types in bioassessments and ensure that key environmental gradients are adequately represented in sampling designs.