

2006 AES Report – Nels H. Troelstrup, Jr., P.I.

The objectives of this effort are to (1) develop and maintain a comprehensive voucher collection and ecological database of aquatic macroinvertebrates inhabiting prairie aquatic systems, (2) develop load-response relationships between priority non-point source contaminants and optimal measures of macroinvertebrate community structure and (3) develop demonstration and educational outreach programs to showcase linkages between nonpoint source loadings of priority pollutants and measures of biological integrity. It has been estimated that headwater streams comprise more than 70 percent of stream miles within the United States. Intermittent, headwater streams in Kingsbury County, SD were observed to harbor 16 orders, 47 families and 101 genera of aquatic invertebrates. Invertebrate community indicators were able to discriminate between impaired headwater streams and headwater reference sites. Significant correlations were observed between invertebrate community indicators and local channel substrate and riparian vegetation measurements. Results of this effort suggest significant linkages between localized land management practices and invertebrate community characteristics. Water quality, habitat and macroinvertebrate data were also collected from 58 aquatic habitats in 13 national parks to establish baseline characteristics for future monitoring. Aquatic invertebrate family diversity was highest in small-medium sized streams (79 families), moderate in large rivers (61 families) and lowest in headwater spring habitats (31 families). Feeding guilds were dominated by gathering collectors in all stream habitats. However, shredders were most abundant from headwater springs and filtering collectors were most abundant from large rivers as predicted by the River Continuum Concept. Over 70% of the variability among sampled park sites was explained by two principle components. Site cluster separation in ordination space was highly correlated with tolerance to organic pollution and taxonomic diversity. A water quality monitoring plan was developed for the Northern Great Plains Network of parks using data collected from this effort. Efforts to understand the influence of high sediment loads on lake invertebrate communities were expanded at Oak Lake Field Station this past summer. High concentrations of suspended solids are an important cause of water quality impairment throughout much of the world. This impairment includes loss of aquatic life uses which must be quantified for adequate development of total maximum daily loads. Experimental sediment loads spanning the regional range (0, 250, 2500, 25000, 250000 kg/ha/yr) were administered in pulsed treatments to 10 cattail bed sites along the shoreline of Oak Lake, SD. Gathering-collector invertebrates were reduced (7.7%) relative to control plots. However, most community characteristics remained similar to control plots in these depositional habitats. A second experiment will be conducted in rocky-shoreline habitat during summer 2007. Results of this effort will facilitate development of total maximum daily loads for sediment in eastern South Dakota for protection of aquatic life uses.

AES Public Value

Results of these efforts demonstrate that (1) invertebrate communities within intermittent, headwater streams are highly diverse and respond to alterations in stream habitat and riparian characteristics in northern prairie habitats. (2) Aquatic invertebrate community

guild structure in lotic habitats of the Northern Great Plains Network (NPS) generally varies with stream size as predicted by the River Continuum Concept. However, significant spatial variation in invertebrate community characteristics is correlated with differences in organic pollution tolerance and diversity among parks. (3) Regional annual sediment loads entering prairie lake basins have little effect on invertebrate community structure within existing depositional habitats. Prairie stream and lake littoral habitats exhibit high invertebrate taxonomic and guild diversity useful for monitoring the effects of environmental change.

Research Products

Troelstrup, N.H., Jr. and J.D. Rust. 2007. Vital signs monitoring in our parks: What to measure? Proceedings of the South Dakota Academy of Science (In Press).

Lorenzen, P.B. 2006. Optimal macroinvertebrate metrics for assessing biotic integrity of intermittent prairie streams. MS Thesis, Department of Biology & Microbiology, South Dakota State University, Brookings, SD. 161p.

Rust, J.D. and N.H. Troelstrup, Jr. 2007. Descriptive analysis of aquatic invertebrate communities in wadable and non-wadable streams of the Northern Great Plains Network. Proceedings of the South Dakota Academy of Science (In Press).

Rust, J. 2006. Establishing baseline data for aquatic resources in national parks of the Northern Great Plains Network. MS Thesis, Department of Biology & Microbiology, South Dakota State University, Brookings, SD. 177p.