2005 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. Fecal contamination from warm-blooded animals is one of the most frequently encountered water quality problems within South Dakota. A statewide database of E. coli isolates from livestock, domestic pets and human sources was assembled and submitted to the South Dakota Department of Health. Antibiotic resistance analysis (ARA) was evaluated as a potential bacterial source tracking method for South Dakota. Correct classification rates of known source animal E. coli isolates ranged from 7.5% to 56.7% from the entire database across all four ecoregions. Discrimination between human and non-human sources was found to be 65%. ARA analysis may present a useful screening tool to identify human versus non-human sources but is unlikely to present a viable discrimination tool for large areas with multiple animal sources. Water quality, habitat and macroinvertebrate data were collected from 58 aquatic habitats in 13 national parks. Macroinvertebrate samples collected from bison watering holes, springs, streams and large rivers contributed 4 phyla, 8 classes, 20 orders, 95 families, 271 genera and 323 individual invertebrate taxa. Arthropods contributed most to macroinvertebrate diversity in all four habitat types. Specimen counts were used to characterize macroinvertebrate community metrics, leading toward recommendations of ten optimal community measurements for each habitat. Data collected from this effort will provide a baseline for future monitoring of park conditions and provide regional reference data for monitoring streams and rivers outside park boundaries. Replicate experimental plots (2m x 2m) were established within the shoreline of the Oak Lake basin in eastern South Dakota and sediment added at four levels covering the range of sediment loading rates from watersheds in the Mississippi River drainage (0.04 – 5.44 kilograms per square meter per year). Macroinvertebrates were sampled one week prior and one week following addition of sediment. No significant differences were observed among treatment levels for macroinvertebrate family abundance, familial diversity, familial guild structure or familial pollution tolerance. These results contrast with those of earlier sediment plot studies which did demonstrate sedimentation impacts to basin macroinvertebrate communities. Planning for a statewide aquatic biomonitoring symposium was initiated with state partners. The purpose of this symposium will be to initiate communication of aquatic bioassessment activity within South Dakota and define government partner information needs. The symposium has been scheduled for October 2006.

AES Public Value

Results of these efforts demonstrate that (1) antibiotic resistance analysis may be a cost-effective screening tool for fecal contamination but is unlikely to discriminate among multiple animal sources across broad spatial areas, (2) there is significant variability in aquatic macroinvertebrate communities among relatively undisturbed national park sites

and habitats and significant relationships exist between macroinvertebrate community structure and disturbance gradients related to water quality, channel habitat and riparian conditions and (3) the immediate effects of sediment loading at rates observed throughout the upper Mississippi River drainage did not result in changes to family-level macroinvertebrate community structure beyond that expected from normal variation.

Publications

Troelstrup, N.H., Jr., B. Bleakley, E. Jorgensen. 2005. Fecal coliform strain identification project. Final completion report submitted to the South Dakota Department of Environment and Natural Resources, Pierre, SD.

Troelstrup, N.H., Jr. 2005. Aquatic ecosystems monitoring in the Northern Great Plains Network. Presented during the Annual Meeting of the National Park Service I&M Network, Rapid City, SD.

Troelstrup, N.H., Jr. 2005. The Lake Campbell phytoplankton bloom of 2005. Presented to the Lake Campbell Association, Lake Campbell, SD.

Carroll, D. 2005. The effects of sedimentation on the invertebrate assemblage within a lacustrine littoral zone. MSc Thesis, Manchester Metropolitan University, Manchester, England. 65p.

Jorgenson, E. 2005. Use of antibiotic resistance analysis as a bacterial source tracking technique to facilitate water resource management in South Dakota. M.S. Thesis, Department of Biology & Microbiology, South Dakota State University, Brookings, SD. 190p.

Rust, J.D. and N.H. Troelstrup, Jr. 2005. Description of aquatic resources in national parks of the Great Plains Network. Proceedings of the South Dakota Academy of Science (Abstr, In Press).

Rust, J.D. and N.H. Troelstrup, Jr. 2005. Insect communities in aquatic systems of the Great Plains Network. Presented during the 2005 Natural Areas Conference, Lincoln, NE.