Project Proponents:

Nunavut Research Institute
Box 1720, Iqaluit
Nunavut, Canada
X0A 0H0

Contacts:
Jamal Shirley
647-979-7290
jshirley@nac.nu.ca

York University, Biology
247 Farquharson Building
4700 Keele St, Toronto, ON
M3J1P3

Andrew Medeiros / Roberto Quinlan
416-736-2100 x40076
fraggle@yorku.ca / rquinlan@yorku.ca

Project Summary:

Objectives: To assess and identify the extent of long-term biological impairment from multiple stressors in the streams and rivers of the South-Baffin region of Nunavut.

Outline: Arctic freshwater streams and rivers are highly specialized systems that are susceptible to a wide variety of anthropogenic disturbances. The examination of bio-indicators that respond to changes in temperature, dissolved oxygen, nutrients, and pollutants can thus be used to infer the overall health of these systems. In order to establish a long-term monitoring program to assess the ecological integrity of these systems, these indicators are used to determine any deviation from the established baseline conditions. Since most monitoring protocols in use are based off of research in southern temperate systems, the assessment of Arctic tundra streams requires the development of predictive reference model. As there are also no measures of what a 'pristine' habitat is, a reference condition approach is necessary to determine the baseline conditions of the benthic invertebrate communities of undisturbed streams. While the reference condition approach will require a large sampling commitment for the initial assessment phase, it will allow for the selection of parameters to use in an index which is ecologically significant as well as and based off of the predictive model developed from the reference conditions of 'pristine' tundra streams. Thus, comparing 'pristine' and 'disturbed' benthic invertebrate communities in Nunavut streams will require a model and indices to distinguish the threshold values for qualitative labels of health.

While models and indices of biological integrity have been applied to benthic invertebrate communities on the family level in southern temperature systems, these cannot be used in tundra streams due to their inherent low diversity. Therefore, the index used must be based upon a meaningful measure of diversity, such as the dominant species found within the undisturbed habitat of the tundra streams characteristic of Nunavut. The dominant family of benthic invertebrates of Nunavut aquatic systems is the Chironomidae (Insecta: Diptera). Within this Family, wide differences in ecological preferences and environmental constraints exist between genera. Thus, the identification of specimens to the genus (and possibly species) level of organization is necessary as a typical rapid bioassessment protocol, which identifies specimens to Family level, could be insensitive to detecting biological impairment. The focus on the intra-genus diversity of the Chironomidae will therefore allow for the identification of changes in abundance as well as compositional change their communities in response to ecological disturbances.

Research Questions: What are the environmental variables that influence the baseline benthic invertebrate communities? How much do stream and river systems have to be disturbed before there is a shift in the dominant Chironomidae community? How do we quantify 'pristine' versus 'disturbed' stream communities? How do we measure the impact of a perceived disturbance to stream health?

Methods:

While field sampling took place in 2003 and 2004 in the Peterhead Inlet area of Baffin Island to establish the base community composition of a 'pristine' stream site, the specimens collected were not identified to the genus level of organization. Since the diversity of Nunavut streams is low, the identification of these reference samples to the genus level of organization is necessary for use in the creation of the reference index model for biological assessment of health. Selected streams (e.g. Apex River, Airport creek) will be sampled weekly during the ice-free season on a yearly basis starting in 2007 (for the initial 2 year assessment phase) for benthic invertebrate communities with the use of the Ontario Benthic Bio-Monitoring Network Protocol (Jones, 2003). A D-Net with a 30x30 opening and 500um mesh size will be utilized for invertebrate sampling. The D-net is placed firmly on the substrate and used to collect disturbed substrate in a zigzag formation 12-14 inches upstream from the operator. Each sampling event is for a duration of 5 minutes, and repeated in triplicate. Samples are then transported to the Nunavut Research Institute, sorted and identified to genus with the use of a dissecting microscope, and preserved in 70% ethanol. Water chemistry data will be collected for the reference-stage years of index model development and transported to the Canadian Center for Inland Waters (CCIW) in Burlington, Ontario for analysis (variables; TP, TKN, NH3, DOC, Cl-, Na+, SiO_4, SRP, K+, Ca+, Mg, DIC and Trace Metals) . Environmental variables, such as temperature, DO, Conductivity, pH, and Oxygen Reduction Potential) will also be recorded during the time of field sampling with the use of a YSI multi-parameter probe. These data will then be analyzed with the use of simple and multivariate

Significance: While benthic monitoring programs are commonly used to assess the health of streams and rivers in temperate systems, the inherent low diversity of Arctic tundra streams makes the use of these indicators difficult. However, Bailey *et. al.* (1998) was able to successfully distinguish disturbed streams (due to mining contamination) from pristine environments in the Yukon with the creation of predictive model based upon a reference condition approach. By integrating this reference condition approach for establishing the baseline community composition of Nunavut streams with the identification of the major taxa to the genus level, a predictive model of ecosystem health, based on the benthic invertebrate community structure, can then be created. The use of this model will then allow for the long-term monitoring of the ecological integrity of several streams within Nunavut, including those that have been identified as potentially contaminated by industrial pollutants.

References:

Bailey, R.C., Kennedy, M.G., Dervish, M.Z., and Taylor, R.M. (1998). Biological assessment of freshwater ecosystems using a reference condition approach: comparing predicted and actual benthic invertebrate communities in Yukon streams. *Freshwater Biology*; 39:765-774.

Jones, C., Somers, K., Reid, R., Fletcher, R., Winters, J., Reynoldson, T., and Craig, B. (2005). Ontario Benthoc Biomonitoring Network Procotol Manual. Ontario Ministry of Environment and Environment Canada: Dorset, Ontario.