Research Proposal

Development of a Long-term Ecological Monitoring Program at Denali National Park and Preserve as a Prototype for National Parks in the Subarctic:

Methods to classify streams using biotic communities for use in long term ecological monitoring of stream ecosystems

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Background and Rationale

In 1992, Denali National Park and Preserve was selected as one of four parks for development of a long-term ecological monitoring program. The Denali program was to be developed as a prototype for other parks in the subarctic. This Research Work Order will continue work on development of methods for monitoring changes in biological productivity of streams using macroinvertebrates.

Development of stream classification within Denali National Park and Preserve is an essential approach to selecting suitable stream sites within watersheds for long term ecological monitoring. Streams may be classified in a number of ways based upon such variables as their water source, hydrology, gradient, stream order, channel type, geology and fish populations. Macroinvertebrates integrate processes occurring at the watershed scale and are responsive to such variables as gradient, discharge, water chemistry, geology and riparian zone characteristics as well as instream habitat differences.

To further this concept of defining watershed types by their streams and the macro-invertebrate fauna they support, Roberts and Milner (1995) commenced work in 1994 examining the macroinvertebrate fauna of 26 streams along the road corridor. Five major stream types were identified using multivariate classification techniques (TWINSPAN). In 1995 this study was extended to include sites at the west end of the Park and on the south side of the Alaska range and over different times of the year to examine seasonal variation. These additional stream sites were found to classify into different groups (Roberts and Milner 1996). Associated with the macroinvertebrate study we were fortunate to have extensive water chemistry data for all these stream sites provided by an associated study together with physical measurements. Using correlation analysis we were able to show that channel stability and nutrient levels were the most important physicochemical variables determining the macroinvertebrate community structure. Watersheds on the south side of the Alaska range flowing into Cook Inlet were found to be different from north flowing rivers.

In 1996 we selected 2 streams from 5 watershed types and looked at longitudinal variation along these systems to ascertain within stream variation . It appears that there is more between stream variation than within stream variation as all the stream sites within a stream type were classified within that type and were distinct from other stream types although analysis is ongoing (Roberts and Milner 1997). This allows us to reduce the number of monitoring sites required to adequately monitor each stream.

In 1997, we selected a small number of sites in different watershed types that had not previously been sampled and collected benthic invertebrates. We also collected data on the identified key variables and will use this as a pilot to see if we can correctly predict the community structure given no impairment. The data analysis through 1997/98 has produced the predictive model to provide classifications of streams based on eight physicochemical parameters and testing showed that new sites were correctly classified at an accuracy exceeding 90 (Roberts and Milner 1998).

The next step in the development of suitable methods is to recalibrate the model by looking at year to year variation in the community structure and metrics, examine other possible methods of collection of aquatic invertebrates and evaluate other possible biotic groups to include in the monitoring.

Objectives

The overall objective is to develop ecologically-relevant, cost-effective, and statistically-sound methods of monitoring the biological productivity of streams, as part of an integrated long-term ecological monitoring program, suitable for national parks in the subarctic.

1 Assemble the four years of data collected and deliver to Jon Paynter following the Denali Data Management protocol and provide metadata in a word processor format (following the table of Michener et al. 1997) by December 31, 1998.

2 Produce a variables assessment report that assesses the value of the protocol as currently developed in the final report due June of 1998 with a discussion of observed variation, power considerations, cost and logistical considerations to suggest whether the method meets the stated objectives. Included in this report will be a discussion of how to scale up and its relation to other biomonitoring projects within Alaska. This report would also explore the links to other disciplines including the terrestrial insects, the birds, the soils and the vegetation and the connections between the stream group classifications and geology and vegetation maps. This report would be provided by March 31, 1999.

3 Within each classification group of streams select 2 sites for 3 further years of monitoring - this would provide important long term information on natural variability in benthic macroinvertebrate communities and is essential to recalibrate the predictive model and see if year to year changes are significant. Few databases extend past 2 years (normal length of studies) and thus we do not have a good idea of how taxa turnover influences community structure. Unpublished data indicates that at these northerly latitudes there is significant year to year variation in taxa abundance and presence and this would be important to quantify and its significance for other biomonitoring projects. Five macroinvertebrate samples would be collected at each site during two time periods, generating 80 samples per year

4 Sample a number of impaired sites in the Kantishna area to

help determine the scale of the bands at which impairment can be distinguished when comparing the observed values with the expected. This is an important process and will also depend upon the range of natural variability determined in (3).

5 Examine other possible sampling techniques for comparability including the use of a D net and then sub-sampling the organisms collected. This may result in easier processing of data for personnel involved in the monitoring. This would involve collecting replicate samples with the D net to those collected in (3) above over 2 different sampling periods.

6 To date this study has focused on macroinvertebrates but it is proposed in the next phase to look at other aspects of the biotic community, in particular algae growing on the substrate. This may involve using chlorophyll a as a surrogate for algal biomass or examining the potential of using diatom communities which have proved useful for the biomonitoring of streams (Round 1993)

7 Travel to meetings and participation in the development of a conceptual model that ties in the various facets of the long term ecological monitoring program.

Methods

Methods will follow those outlined in Roberts and Milner (1996;1998) and Round (1993)**.**

Reports and Deliverables

1	Metadata in word processor format for 1992-1997 data to NPS Data Manager	December 31, 1998
2	Annual report of past summer's study effort for NPS Administrative reports	December 31 each year
3	Variables assessment report:	March 31, 1999
4	Yearly summary reports of objectives 3-6	March 15, 1999, 2000, 2001
5	Thesis plan	December 31, 1998
6	Thesis	September 30, 2001

Period of Performance

The period of performance of the work order is from the date of signature of the Government Project Officer through 30 September 2001.

Project Officers

This project is being conducted under the auspices of the Alaska Cooperative Fish and Wildlife Research Unit. The Project Officer designated below is responsible for coordinating the different parties in the project.

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