The Ontario Benthos Bioassessment Network

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Abstract

We are initiating the Ontario Benthos Biomonitoring Network (OBBN), a multi-partner aquatic biomonitoring network, co-founded by the Ontario Ministry of Environment's Environmental Monitoring and Reporting Branch and Environment Canada's Ecological Monitoring and Assessment Network. As background, we discuss the importance of biomonitoring; explain why benthic invertebrates are good indicators of aquatic condition; summarize the OBBN purpose, components, and proposed implementation model; and explain the reference-condition approach to bioassessment, which we recommend for the network. The role we propose for Ontario Parks is also discussed.

Introduction

A number of barriers to aquatic biomonitoring currently exist in Ontario, including: no standard protocol, no mechanism for sharing data, and a lack of training and taxonomic certification for practitioners. The Ontario Benthos Biomonitoring Network (OBBN) is being developed to remove such barriers, and is viewed by Environment Canada's Ecological Monitoring and Assessment Network (EMAN) as a pilot project for a program that could ultimately standardize lake, stream and wetland aquatic biomonitoring across Canada.

Biomonitoring evaluates biological responses to a range of natural and human factors directly, and is important because the end-points of water management (e.g., protection of aquatic biota and their habitats), and legislative definitions of aquatic impairment, are often biological. Furthermore, biomonitoring is complementary to physical habitat and chemical monitoring approaches, both of which are widely applied in Ontario. The Ontario Ministry of Environment (MOE) water management policy "Blue Book" (Ontario Ministry of Environment and Energy, 1994) states that *"with respect to surface water quality, the goal is to ensure that the water quality is satisfactory for aquatic life..."*. Similarly, the *Ontario Water Resources Act* (R.S.O., 1990, c. O.40) specifies that *"the quality of water shall be deemed to be impaired if...the material discharged ...causes ... injury to any person, animal, bird or other living thing..."*. Several components of the *Ontario Environmental Protection Act's* (R.S.O., 1990, c. E.19) definition of adverse impact are biological, including:

- impairment of the quality of the natural environment for any use that can be made of it;

- injury or damage to property or to plant or animal life;
- an adverse effect on the health of any person; and,
- rendering any property or plant or animal life unfit for human use.

The "Gibbons' Report", a commissioned government report entitled *Managing the Environment: A Review of Best Practices* (Executive Resource Group, 2001), explained that leading jurisdictions are using biomonitoring to provide early warning of watershed stress. The report asserted that *"MOE has not kept pace with leading US states in developing...biomonitoring approaches"* and, in recommendation #8, stressed the need to invest *"in the development of indicators and biomonitoring approaches"*.

Benthic macro-invertebrates, or benthos, are large, bottom dwelling insects, crustaceans, worms, molluscs and related aquatic animals. They are good integrators of environmental impacts because their patterns of abundance reflect responses to multiple stressors. Benthos can be used as early warning indicators because they respond relatively quickly to perturbations, potentially before irreversible ecosystem damage occurs. These animals have a number of traits that make them ideal for use as indicators:

- they are relatively sedentary so they can't swim or fly away from impacts like fish and ducks can, and they are long lived;
- they respond to changes in water and sediment quality, and are abundant in most aquatic ecosystems;
- their community composition reflects responses to multiple stressors ; and,
- they are easily collected and identified, and sampling them does not significantly impact an economic or recreational resource (another difference from fish and ducks).

Recognizing the benefits of using benthos as indicators of aquatic health, the Ontario Benthos Biomonitoring Network has the following objectives:

- to enable assessment of aquatic habitats (wetlands, streams, lakes) using benthic macro-invertebrates;
- to provide a biological performance measure related to management of aquatic systems; and,
- to provide a biological complement to the Provincial Water Quality Monitoring Network (a water chemistry monitoring program coordinated by MOE).

Implementation Model

The OBBN will be coordinated through the Dorset Environmental Science Centre of the Ontario Ministry of Environment, with direction from a multi-stakeholder Technical Advisory Committee. It will be implemented on the principles of partnership, free data sharing, and standardization. The network will have three components:

- a standard cost-effective protocol that can be tailored to suit the budget and expertise of network partners;

- training in sampling and invertebrate identification to ensure comparable results;
- a shared database of reference and test site data; and,
- software that will automate data storage, retrieval, analysis and reporting.

Founding partners (MOE and EMAN) will coordinate the network, provide scientific guidance, technical support, and limited sampling equipment. Partners (expected to include: Conservation Authorities, Environment Canada, Ontario Parks, academics, municipalities, and volunteers) will provide technical input and assist with sample collection.

Potential Role for Ontario Parks

We see two roles for Ontario Parks in the OBBN. Because provincial parks often contain areas where human activities have had minimal impact on ecosystem function, they may contain suitable reference sites that could be used to define "normal" biological condition. The first role that we propose for Ontario Parks, therefore, is to cooperate with OBBN partners to identify reference sites within Ontario's parks that reflect minimally impacted lake, stream, and wetland conditions.

The second role that we propose for Ontario Parks is a sampling role. We encourage Ontario Parks staff to collaborate with OBBN partners to periodically sample reference sites, and a network of test sites that will assist with park management by evaluating aquatic health and the performance of management activities.

Proposed Aquatic Bioassessment Model

We recommend a reference-condition approach to bioassessment because biological aquatic health standards are generally absent. The reference-condition approach (RCA) uses the biological condition of minimally impacted sites to establish the normal range of conditions to be expected at test sites. The RCA has five steps:

1. minimally impacted reference sites with a range of physiographic characteristics are sampled;
2. reference sites with similar benthos communities are grouped and the physiographic attributes distinguishing the groups are noted;
3. the range of biological variation within groups of reference sites is established to define "normal";
4. the physiographic and biological characteristics of a test site are measured; and,
5. the test site is matched with the physiographically most similar reference site group and its biological condition is compared to the normal range of biological conditions found within the reference group.

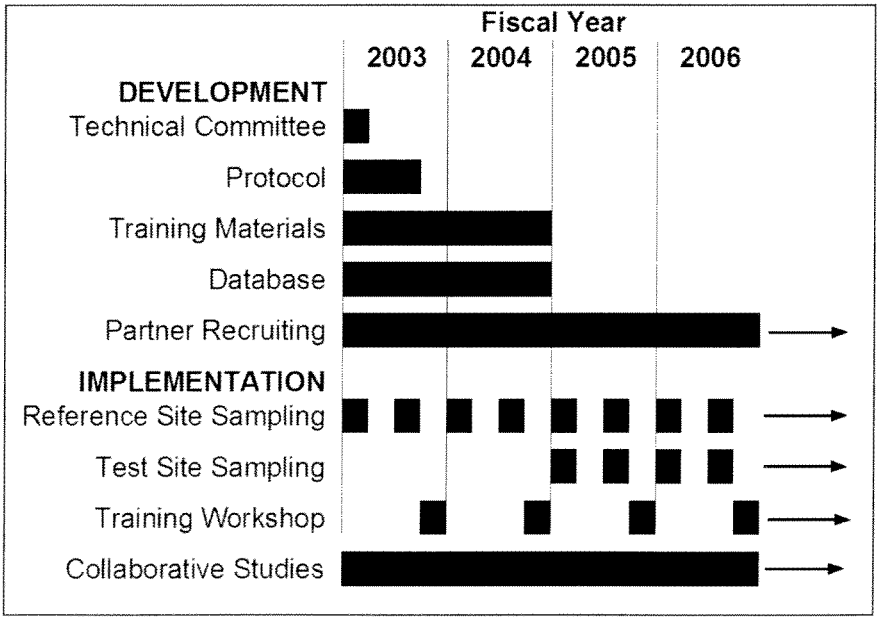
When the biological condition of a test site is unusual (i.e., it falls outside the normal range as defined by reference sites) further investigation is needed to determine if the

observed differences were caused by human activities.

Schedule

We expect the OBBN to be fully implemented by the end of fiscal year 2004 (see Figure 1). The Technical Advisory Committee was assembled in spring 2003 and is reviewing a draft protocol manual. The final protocol manual will be abailable in fall 2003. We anticipate having the database and analytical modules available by spring 2004. A number of partners are currently involved in sampling minimally impacted reference sites, and we expect test site sampling to begin in 2005, once a reasonable reference condition database has been assembled. Collaborative studies will be used to resolve unanswered scientific questions as the network is developed.

Figure 1. *Ontario Benthos Biomonitoring Network implementation schedule.*



Summary

Biomonitoring is an important part of aquatic ecosystem management and benthic invertebrates have a number of traits that make them ideal indicators of aquatic health.

The objectives of the Ontario Benthos Biomonitoring Network are:

- to enable assessment of aquatic habitats (wetlands, streams, lakes) using benthic macro-invertebrates;
- to provide a biological performance measure related to management of aquat-

ic systems; and,

- to provide a biological complement to the Provincial Water Quality Monitoring Network (a water chemistry monitoring program coordinated by the Ontario Ministry of the Environment).

The OBBN will be built on a foundation of partnership, free data sharing and standardization. Its components, which include a standard protocol, training, and an internet database that automates analysis, will remove current barriers to biomonitoring in Ontario. We expect the network to be fully operational by the end of fiscal year 2004.

To successfully implement the OBBN, we need feedback and support from all partners. As a key network partner, we encourage Ontario Parks to assist with reference site sampling and to build long-term benthos monitoring programs to support park management.

References

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