Improving the Effectiveness of Great Lakes Research

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WHITE PAPER ON IMPROVING THE EFFECTIVENESS OF GREAT LAKES RESEARCH

Preamble

The Council of Great Lakes Research Managers (CGLRM) was set up in 1984 to enhance the ability of the IJC to provide effective leadership, guidance, support and evaluation of Great Lakes research programs with particular reference to programs required or funded pursuant to the provisions of the Great Lakes Water Quality Agreement (GLWQA). The membership of the CGLRM comprises persons responsible for research programs related to the implementation of the GLWQA.

In October, 1995 the IJC asked the CGLRM to take the lead in developing an approach to the issue of "Improving the Effectiveness of Research in the Great Lakes." The issue emerged from the results of the "Public Forum on the Future of Great Lakes Science" which was held at the IJC's Biennial Meeting in Duluth, Minnesota in September, 1995. The CGLRM's response was to survey the Great Lakes research community to determine the magnitude of and areas impacted by research budget cuts and then to involve researchers and research managers in identifying ways to ensure the continuation of needed research, but accomplish major cost savings. These savings will not only be realized by creating efficiencies in research programs, reducing overlap, and setting priorities, but also by strengthening the link between research and management. This is because management actions not based on science or supported by research are often misguided and more costly than they should be. Management guided by research can help ensure achievement of ecosystem results and avoid many expensive wrong turns.

The CGLRM believes that the quality of Great Lakes research is world class, especially in the area of application of an ecosystem approach in research of aquatic systems. An indication of this is the interest in research results from the Great Lakes throughout North America, Europe, Africa, and Asia, and the requests for collaboration and technical assistance from all over the globe. This white paper is intended to encourage greater dialogue and to foster fruitful discussion on the issue of making this work more effective.

The focus of ecosystem research and management has inevitably been drawn from the open-lake towards the nearshore. Much of each lake's productivity occurs in the nearshore zone or is initiated there. Past habitat alterations and losses have been concentrated in the nearshore and adjacent lands. Many of the impacts of

exotics are most evident in the nearshore (zebra mussels, purple loosestrife, etc). Remedial Action Plans (RAPs) have played a significant role in promoting this shift from offshore to nearshore and from a largely chemical view to a broader ecosystem perspective. The Lakewide Management Plan (LaMP) effort should continue the process of integration of offshore, nearshore and watersheds.

The 1996 Great Lakes - St. Lawrence Research Inventory currently contains 408 research projects and programs representing $ 71 million (U.S.) in research funding. Nearshore and nearshore-related projects account for 22% of the total projects and 35% of the total funding. Of the total U.S. funding, 19% was devoted to nearshore work, while 60% of Canadian funding went to nearshore projects. The current emphasis of Canadian funding reflects recent reductions in spending for open lake programs.

The Research Inventory was searched for projects with keywords relevant to the SOLEC Working Paper topics. Although there was some overlap of topics, 24 projects were identified that dealt with Coastal Wetlands and 21 projects were found that addressed Land Use by the Lakes. While there were many projects that assessed the impact of land use, there was only one that considered nearshore land use specifically.

Purpose

The CGLRM notes that Great Lakes problems requiring research support are more complex than they have been in the past. Not only must researchers strive for better science to meet these challenges, but, since long-term, sustaining solutions will be more costly, there is a need to engage members of the Great Lakes community in the identification of cost saving strategies to share information and facilities, and develop partnering approaches to the conducting of research. Also, the research community should be involved in setting research priorities so that areas for budget reduction will be identified logically and new approaches can be found for areas that receive no new funding. Further, the CGLRM seeks to identify research that is most responsive to resource management goals.

Successes and Challenges

Over the past 30 years, the results of Great Lakes research have been applied to a variety of problems. Many of these efforts have been successful, although most still face a number of challenges. The CGLRM perceives the utility of briefly cataloguing some of these successes in the hope that some common threads will emerge. Also, the CGLRM wishes to remind researchers and managers alike that it is rarely the case that an environmental problem is solved so completely that some level of follow-up monitoring and assessment is unnecessary.

One of the greatest successes for ecosystemic research and management is the recovery of Lake Erie. Focussed research identified the causes of eutrophication and oxygen depletion that were responsible for the lake being labelled "Dead" by the media. Aquatic ecosystem modelling led to target phosphorus loads for Lake Erie. Research on nonpoint pollution identified the contributions to phosphorus loading from agriculture and this led to promotion of best management practices. Engineers determined the treatment technology needed to reduce phosphorus in point sources. When this binational effort was put into action, Lake Erie responded as predicted. Phosphorus concentrations in the lake declined dramatically, blue-green algal blooms were much less evident, and oxygen was depleted at a reduced rate, with no anoxia being observed during the last three years. The broad success of phosphorus control efforts in the Great Lakes influenced eutrophication management globally. Yet some challenges remain. The invasion of zebra mussels and other aquatic nuisance species has had repercussions on the upper trophic levels in the lake that have put additional strain on fish populations. Also, subsequent to the zebra mussel invasion, blue-green algal blooms have begun to reoccur in the Western Basin. This situation points out the need for a continued, viable research effort that can respond to new problems, help elucidate cause-and-effect relationships, and provide advice on lessons learned to other areas of North America or the world.

Another accomplishment has been the role of research in the more successful RAPs such as Green Bay, Hamilton Harbour and many others that have used research results in planning and implementation. For example, research has been targeted at the causes of impaired beneficial uses such as contaminated sediments, combined sewer overflows and inefficient treatment facilities. Environment Canada and U.S. Environmental Protection Agency funded the evaluation of dozens of sediment treatment technologies including demonstrations at bench, pilot, and full-scale. These programs fostered the development of innovative technologies, and expanded the information base on technologies suitable for use in RAPs. Optimization of control systems for combined sewer overflows incorporating collection, storage and treatment components is another fruitful area of research which benefits urban Areas of Concern (AOCs). Satellite treatment systems are expected to be significantly more cost effective than other options and, if proven feasible, could create potential savings of several hundred million dollars for municipalities with combined sewer overflow problems. The challenge that remains is to strengthen the link between research and management for all areas of the Great Lakes. The challenge for the Great Lakes research and development community is to maintain the momentum in the development of cost-efficient remediation technologies that was started with programs like the Assessment and Remediation of Contaminated Sediments and the Great Lakes Cleanup Fund. Complete remedial actions have been implemented at only a handful of AOCs, and the scale of problems such as in-place sediment contamination and overloaded sewers can overwhelm the resources of many RAPs. Further development of several remediation technologies is necessary to optimize their performance and bring them to full-scale capability.

Nipigon Bay on Lake Superior has been subjected to a variety of stresses over the last century, including eutrophication, atmospheric loading of contaminants, alteration of physical habitat, point source discharges and exploitation of forests and fisheries. Since the inception of commercial fishing, walleye and lake sturgeon have been extirpated and the abundance of other important species has declined significantly. To address these and other problems, a partnership among the research community, resource management agencies, industry and the public was formed through the Nipigon Bay RAP to:

1. Identify the multiple stresses acting upon the Nipigon Bay ecosystem,
2. Establish objectives for remediation,
3. Prioritize the contaminant stresses for reduction,
4. Rehabilitate affected habitat,
5. Effect change in water management and resource exploitation practices, and
6. Track and assess progress in the restoration of beneficial uses.

Although not all stresses on Nipigon Bay have been relieved, the initial results have been encouraging and the abundance of two fish species dependent on this ecosystem has increased. The marriage of science, management and remediation in this effort has provided relief from multiple stresses in a logical process which benefited the ecosystem as an entity.

A multi-agency research program, Project Quinte, has tracked a succession of ecosystem changes since 1972 in the Bay of Quinte AOC. The long-term, diverse, multi-trophic research studies, spanning from nutrients to fish, have had two major impacts. First, the Project has provided a unique, continuous record of a Great Lakes ecosystem responding to phosphorus controls under the 1972 GLWQA, and later to increases in the abundance of the major fish predator, walleye. Now, the ecosystem-wide impacts of the on-going zebra mussel invasion are being assessed. This work has produced significant insights into the dynamics of a large, productive bay. Second, the Project provided the basis for the RAP process, beginning in 1985. Existing Project data were used to produce the Stage I report. The data and the accumulated experience and expertise of the research team were applied to the identification and evaluation of remedial options in Stage II. Much of the information was synthesized into models allowing alternative options to be evaluated objectively and communicated to decision-makers. The Quinte RAP would have been severely hampered if the pool of data and expertise represented by Project Quinte had not existed. In recent years, the emphasis has shifted to RAP implementation while research budgets and staffs have been overburdened by a widening array of problems

and cuts as part of government downsizing efforts. As a result, the research contribution is reduced and many ecosystem management issues are unresolved. The core Project Quinte assessment studies, which underpinned all past management advice, are barely being sustained. For example, a unique effort to develop a watershed-wide system for phosphorus load quotas and allocation is faltering for lack of research input and resources.

The evolution of an ecosystem approach through RAPs and LaMPs has broadened the concept of environmental assessment to encompass habitat loss and degradation, the still-growing problems of exotics, and the need to understand productivity in relation to biodiversity. It has increased awareness that actions can no longer be taken "in a vacuum." However, a big challenge that confronts the Great Lakes research community is the quantitative understanding of the effects of multiple stressors (nutrient loads, toxics loads, flow events, exotics invasions, etc.) taken in concert on multiple response end-points (fish production, water quality, algal growth, bioaccumulation, etc.). Major tasks that still need to be completed include: 1) defining the goals and indicators of ecosystem-based management with biodiversity and ecological sustainability being high priorities, 2) developing biologically-based habitat supply goals and management thereby directing restoration and creation efforts, 3) coming to grips with anticipatory policies for preventing and managing exotics, and 4) establishing nutrient load quotas and allocations on a local basis within each basin, securing past successes against population growth and harmonized with socioeconomic development policies.

Research has played a profound role in developing compelling arguments for toxic substance reduction in the Great Lakes. For example, early in the 1980s toxaphene was discovered in the tissues of lake trout obtained from Lake Siskiwit on Isle Royale. This lake is 60 feet above the level of Lake Superior and has no direct inputs. The only source of toxaphene was from the atmosphere. It was suspected that the origin was from the cotton fields in the southern U.S. As a result of this research, a U.S. ban on the use of toxaphene was issued in the mid-1980s. The Green Bay Mass Balance Study, with the combination of modelling and data collection, was the first formal documentation of the system-wide impacts of resuspension of historically contaminated bottom sediments (i.e., high PCB levels in fish in the bay as a direct result of resuspension events in the Fox River). This study represents the use of state-of-the-art of toxic substance mass balance models to quantify the relationship between loadings and concentration of toxic chemicals in water, sediments, and biota of the Great Lakes. Another example is the development of uniform water quality standards for the Great Lakes states. Recent research was brought together to establish new methodologies for water quality criteria for aquatic life, wildlife, and procedures for limiting bioaccumulative chemicals. These methods formed the basis of the Great Lakes Initiative, which became a formal regulation early in 1996. The challenge that remains is to implement these new controls and verify the ecosystem improvements that occur through sound monitoring and assessment programs.

Great Lakes human health effects research has reported an association between the consumption of contaminated Great Lakes fish and body burdens of persistent toxic substances. Neurobehavorial and developmental effects have been observed in newborn infants of mothers who consume Great Lakes fish. Recent efforts have harmonized the methodological and analytical protocols across these and other studies. This will allow a basin-wide analysis and evaluation of health effects potentially associated with the consumption of contaminated Great Lakes fish.

Budget cuts and research trends

In November, 1995, the CGLRM conducted a survey of major Great Lakes research institutions. The 31 responding research programs represent annual funding of as much as $88 million or greater than 80% of the total funding reported by the CGLRM in 1991-1992. This funding peaked in 1994 and was projected to decline by as much as 50% by 1997. Similarly, salary dollars available for research positions also peaked in 1994 and were projected to decrease by as much as 35% by 1997. The number of researchers followed a similar trend. This survey served to heighten awareness of the overall magnitude of the research budget cuts being proposed. Subsequent reversals in some of these planned reductions have been the positive result of

concern expressed at a variety of levels. However, research funding will always be vulnerable to budget reductions because it is an investment in the future with (sometimes) no immediate payoff.

The results of the survey represent the actual resources available for conducting Great Lakes research. The financial resources could potentially be restored at some point in the future, but the human resources represented by the numbers of researchers are not easily replaced. If research positions are eliminated, it will be very difficult to regain a similar level of expertise. It is often noted that it takes ten years to train and develop effective researchers. This assumes that the accumulated experience represented by established researchers will be available for inter-generational transfer and mentoring. It should also be noted that the ability to conduct research is affected not only by the expertise of the investigators, but also by the achievement of a "critical mass" of researchers at key institutions.

The survey indicated that the largest impacts appear to be in the area of mass transfer of pollutants and load reduction models. 85% of respondents that conduct or fund research in these areas reported that they would experience a decrease in funding for these activities. These reductions would potentially impact the ability to meet research commitments for RAPs and LaMPs, dredging, surveillance and monitoring, persistent toxic substances, nonpoint sources, contaminated sediment, airborne toxic substances, and contaminated groundwater. Another large impact would be in funding for research on ecotoxicology. 67% of respondents reported that they expected a decrease in funding for this work. This would potentially impact the further development of water quality objectives and indicators for rehabilitation of the Great Lakes ecosystem from adverse effects of persistent toxic substances. Other areas of research for which respondents reported budget reductions included the effects of climate change on the water quality, wildlife and habitat of the Great Lakes and the application of the ecosystem approach to fisheries management. The areas targeted for these deep cuts are critical for supporting the type of decision making that led to the successes listed above.

In response to this situation, the CGLRM sees three courses of action: 1) request more money, 2) attempt to do more with less, or 3) do something different and innovative. The first option is to argue to have the funding for Great Lakes research restored to 1994 level. In the current fiscal climate, more resources are unlikely, and even if an argument could persuade legislators to restore funding this year, the vulnerability to research budget cuts would continue in future years. The second option would threaten the continued quality of Great Lakes research. The third option recognizes the reality of shrinking research dollars and attempts to compensate by improving the efficiency of how research is conducted. However, it also emphasizes new directions for research. There must be a balance between focussed investigation and innovative science. It is this option that the CGLRM wishes to pursue with resource managers, researchers, and research managers.

Seven Points for Action

Participants at the Forum on the Future of Great Lakes Science commented that it was a good mechanism to share information on budget and program cuts, and potential impacts, and to elevate the concern for the loss of "intellectual capital" (i.e., experienced scientists and researchers) required to meet the commitments under the Boundary Waters Treaty, Great Lakes Water Quality Agreement, Great Lakes Fishery Convention, and the Great Lakes Charter. In addition, there were suggestions for actions or activities to compensate for program restraint measures in the Great Lakes Basin. In general, these suggested actions and activities can be grouped into the following categories:

- clarify and reach agreement on priorities;
- plan cooperatively;
- share responsibilities in delivery of programs;
- share capital resources;
- build partnerships and cooperatives for better science;
- develop new approaches to science and management issues (e.g., adaptive management); and
- communicate value and benefits of science and research.

Improvements can be made in each of these areas which will achieve better value. These actions and activities are not comprehensive or perfect, but are intended as practical steps that can be taken immediately to ensure that the important research and scientific programs survive to provide the necessary foundation for management. The rate of change in environmental and resource issues, and programs, is accelerating. Therefore, decision-makers in research, science, and management cannot be afraid to change. The suggestions are intended to better manage program constraints, pool resources, form partnerships, target priorities, and still improve effectiveness.

Charge to Audience

Using the seven action items above, identify where the principle is currently put into practice (i.e., where has it been used successfully?) and define where the potential exists for application in the Great Lakes community (i.e., how can we transfer this experience across the Great Lakes basin?). Ascertain the mechanism for action on each item and define the role of the CGLRM, the Great Lakes Fishery Commission and the Great Lakes Commission, as well as other Great Lakes organizations and individual researchers in delivering improvements in the effectiveness of Great Lakes research. Further, determine whether there are any proactive steps that can be taken to strengthen the position of Great Lakes research for the future.

URL: http://www.ijc.org/php/publications/html/effres.html