

GREAT LAKES SCIENCE & POLICY: STRENGTHENING THE CONNECTION

Report of a Survey of Great Lakes Policy Issues

Prepared for the Joyce Foundation

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EXECUTIVE SUMMARY

The International Association for Great Lakes Research (IAGLR) is conducting a project intended to improve communication between Great Lakes scientists and policymakers. Support for this effort is being provided by the Joyce Foundation to help fulfill its mission of strengthening public policies to improve the quality of life in the Great Lakes region.

As part of this project, during winter/spring 2001 IAGLR conducted the *Survey of Great Lakes Policy Issues*, which asked Great Lakes organizations to identify and rank high-priority policy issues in the region, and to identify desired information to assist policymakers in decision-making regarding these issues. Data collected through this survey will enable IAGLR and partner organizations to develop more focused information exchanges among Great Lakes science and policy communities and thus will help advance the scientific foundations of Great Lakes policy.

Interested representatives of participating organizations were asked to serve on a Great Lakes Science-Policy Advisory Board to further guide the project. The Advisory Board's first tasks included reviewing the survey results and reaching agreement on key issues and sets of questions for which IAGLR and partner organizations could strengthen the linkage between Great Lakes science and policy. Survey findings were presented at the Advisory Board's inaugural meeting held June 13, 2001, in conjunction with IAGLR's annual conference at the University of Wisconsin-Green Bay. Key survey findings and Advisory Board recommendations include:

Key Survey Findings

One-hundred-and-fifty stakeholders were invited to participate in the survey, and 65 responses were received. Survey respondents represented a wide range of organizations, on both sides of the International border. Thirty-three responses were received from American organizations; 17 from Canadian organizations; 11 from binational organizations, and four from native organizations. Governments represented included the American and Canadian federal governments, most state governments, and Ontario. Responses were also received from organizations based in universities, from industry, and from "governance" organizations (such as the IJC).

Respondents were asked to identify the top three Great Lakes policy issues that would most benefit from a stronger connection to science. Water quality was considered the most important issue, followed by water quantity and invasive species. Other issues included development, governance, ecology, the use and roles of science, climate change, and fisheries. With a few exceptions, ranking of issues within each organizational type paralleled the overall ranking.

Within these issue areas, a broad range of more specific concerns were noted:

- Water quality encompassed concerns regarding contaminants within all ecosystem components (including the atmosphere and sediments) as well as concerns relating to health risks to humans and to other biota. Respondents would like to use science for a variety of purposes relating to water quality, including understanding existing problems, identifying emerging problems, setting priorities, measuring the effectiveness of policy, and improving policy.

- Concerns relating to water quantity were primarily motivated by the issue of water diversion or export. Science was noted as potentially useful in measuring current resources and predicting their future state, assessing the environmental impacts of water diversion, and in developing policies to protect Great Lakes water.
- Concerns relating to invasive species were dominated by awareness of their ecological impacts, and by the perception that ballast water is their chief means of entry into the Great Lakes. Comments also indicated a widespread view that while there is an adequate scientific understanding of invasive species, what is lacking are effective controls on these species. Science was noted as potentially useful in helping to prevent, through technical, legal or political means, new species introductions; in limiting the impact of species already present; and in understanding these impacts.
- Concerns relating to development most often emphasized the environmental impact of land-based development, particularly in urban areas. Less frequently mentioned were other aspects of development, including the impacts of shipping, and of dredging. Science was noted as potentially useful in assessing the impacts of development, defining the relation between environmental priorities and development, identifying appropriate policy responses, and improving management techniques.
- Issues relating to the use and role of science were most often raised by industry respondents. Concerns included: that scientific results be interpreted and reviewed appropriately, through peer review or other means; that research be adequately supported, so that it is able to provide an effective basis for decisions; that research results be applied; and that science or scientific advice can be politically motivated.
- Concerns expressed regarding ecology included reference to Great Lakes ecosystem health or integrity, as well as concerns relating to habitat protection or restoration.
- Smaller numbers of respondents identified issues of governance, of climate change, or of fisheries, as matters requiring attention.

Most respondents stated that their organization now uses science in formulating or implementing Great Lakes policies. A range of sources of scientific information are drawn on, including the internet, solicited sources (such as consultants), and scientific journals.

Respondents' recommendations for making Great Lakes science more accessible to policy activities most often emphasized the need to improve the dissemination of science, as well as the need to enhance the relevance of science, through improved dialogue between science and policymakers. Improved dissemination was seen as potentially facilitated by: improved translation or summaries of research results; improved access to research results, particularly through centralized databases; and by meetings and other forms of direct communication between scientists and those who use science. Greater relevance of science was seen as potentially facilitated through more opportunities for interaction between scientists and policy makers; greater awareness among scientists of policy priorities; and more focused attention to the policy implications of research.

Advisory Board's Key Issues and Recommendations

On June 13, 2001 at least 35 individuals representing a broad cross-section of Great Lakes Science and Policy organizations met to discuss the survey results pertaining to the International Association for Great Lakes Research project to strengthen the science-policy linkage in the Great Lakes Basin. Participants identified the following key issues that may be used to guide further study in the Joyce-IAGLR Great Lakes Science-Policy Initiative. Comments relating to each issue, as provided by discussion participants, are also provided.

- *Impacts of large livestock feeding operations.* This is an emerging issue, of concern across much of the Great Lakes region, that involves policies and actors at several scales, as well as a range of environmental impacts, on water quality, fisheries, and habitat. The issue may be of special relevance and interest at next year's IAGLR annual meeting, to take place in Winnipeg, Manitoba.
- *Diversion and/or export of water from the Great Lakes Basin.* This issue is now receiving considerable attention, and would benefit from examination of what science is needed to make effective decisions. The issue has several dimensions, including lake levels, the impact of climate change, and the economic implications of diversion.
- *Beach closings.* This issue raises questions concerning regulation, such as whether regulations really protect health, and whether they are based effectively on science. Policy makers identified a need to predict beach closings. Further, there is a need for science to play a critical role in setting uniform and consistent standards. This issue would be highly relevant throughout the basin.
- *Successful and unsuccessful issues.* It was suggested that, beyond focusing on any specific issue, it would be helpful to examine "success stories," i.e. issues in which science has played an effective role. Examples mentioned included the binational phosphorus control program, Green Bay, and the Lower Lakes Reference. It was also suggested that a "success story" be compared with a less successful issue, with the success serving as a "control" in a control/experimental study format. Finally, acid rain was suggested as an example of how science has not been translated well into policy.
- *Other issues.* Several issues were mentioned, without supporting comments: non-point sources, sediments, exotic species, airborne toxics and their regulation, and developing population-specific methods of information/education exchange through which more culturally sensitive indicators of Great Lakes ecosystem integrity may emerge.

1. INTRODUCTION

The Problem

Informing public policy with sound science has long been recognized as a vital need for effective management and protection of the Great Lakes. However, delivering scientific findings to policy-makers in a useful manner has been problematic. Policy-makers have often lacked timely access to scientific information. And when they do have access, this information is often too technical and needs interpretation to be truly useful for decision-making. Clearly, there is a need to strengthen Great Lakes science-policy linkages.

Efforts are underway to address part of this problem. For example, some organizations are identifying emerging research issues (the International Joint Commission's Science Advisory Board). Other organizations provide valuable services by informing the region of legislative developments (Northeast Midwest Institute), or advocating on its behalf (Great Lakes Commission). Still others communicate research findings among the research community (Great Lakes Environmental Research Laboratory, Environment Canada's National Water Research Institute) and to the general public, including students (Sea Grant). Within a broader context, agencies such as the National Council for Science and the Environment are examining how better to link science and policy (NCSE 2000). Yet no agency has emerged as the source for scientific information geared directly at informing Great Lakes policy-makers to advance sound public policy.

The IAGLR Response

IAGLR is uniquely positioned to foster this connection between science and policy. IAGLR's mission is to promote all aspects of large lakes research and communicate research findings. This international, multidisciplinary organization has more than 900 members and provides a broad range of science and expertise to a number of audiences. Each year it convenes the premiere Great Lakes research conference, and the organization has become the repository of Great Lakes science over the years via its *Journal of Great Lakes Research*. Published since 1975, the journal contains the foremost collection of multidisciplinary Great Lakes scientific knowledge in the world.

This combination of both scientists and science positions IAGLR to serve effectively the policy-making community in the interest of advancing sound policy. Building on its strengths, and in keeping with its stated goal of reaching out to policy-makers, IAGLR is conducting a two-year project to lay the foundation for the ongoing exchange of information between scientists and policy-makers, to ensure informed management and protection of the Great Lakes ecosystem.

In December 2000, IAGLR was awarded a grant from the Joyce Foundation to improve communication between Great Lakes scientists and policymakers (IAGLR 2000). This two-year grant supports the following project activities:

1. Survey key Great Lakes policy institutions and organizations to identify high-priority policy issues where further scientific information is desired;
2. Establish a Great Lakes Science-Policy Advisory Board to guide the project;

3. Build a web-based directory of scientists and researchers from the Association who are willing to interact with and answer questions for policy-makers;
4. Build a repository of Great Lakes research based on the *Journal of Great Lakes Research*, readily available and searchable via the Association's web site to provide the scientific background for key issues over time;
5. Identify Great Lakes policy development organizations to partner with IAGLR in a pilot project to address high-priority issues identified by the Advisory Board;
6. Translate the relevant science for policy-makers into a useful, readily accessible format available via the Association's web site;
7. Facilitate dialogue between policy-makers and scientists in answering specific questions, addressing issues, and furthering policy development on priority issues;
8. Evaluate and fine-tune the approaches of the project in strengthening science-policy linkages and develop recommendations for the Association and Great Lakes community regarding continued use of this and other tools; and
9. Disseminate information about the project throughout the two years to advertise the initiative, secure participation, and share results.

This project will use the knowledge that exists in the Association's journal, the expertise of the Association's scientists, and key policy organizations to strengthen the connection between Great Lakes science and policy. It provides the framework for ongoing informed policy by building a readily accessible repository of information and by establishing roles and access to expertise that will serve the policy-making community both during the project and well into the future.

The Purpose of this Report

During winter/spring 2001, IAGLR conducted the *Survey of Great Lakes Policy Issues*, which asked organizations to identify and rank high-priority policy issues in the region, and to identify information that could assist policymakers in decision-making regarding these issues. Data collected through the survey will enable IAGLR and partner organizations to develop more focused information exchanges among Great Lakes science and policy communities and, in so doing, will help advance the scientific foundations of Great Lakes policy.

Interested representatives of participating organizations were asked to serve on a Great Lakes Science-Policy Advisory Board to further guide the project. The advisory board's first tasks included reviewing the survey results and reaching agreement on key issues and sets of questions for which IAGLR and partner organizations could strengthen the linkage between Great Lakes science and policy. Survey findings were presented at the Advisory Board's inaugural meeting held June 13, 2001, in conjunction with IAGLR's annual conference at the University of Wisconsin-Green Bay.

This report describes the research methods used in IAGLR's *Survey of Great Lakes Policy Issues*, and it presents survey findings and Advisory Board recommendations for key issues to guide the Association's remaining project activities.

2. SURVEY METHODS

In early 2001, IAGLR designed and conducted the *Survey of Great Lakes Policy Issues*, which asked Great Lakes organizations to identify and rank high-priority policy issues in the region, and to identify desired information to assist policymakers in decision-making regarding these issues. The survey design and implementation consisted of seven steps, including: (1) developing a project steering committee, (2) establishing rules of inclusion for stakeholder organizations, (3) identifying potential survey participants, (4) designing the survey questionnaire, (5) setting the survey period, (6) contacting participant organizations, (7) data collection, and (8) re-contacting non-respondents.

Developing the Project Steering Committee

In January 2001, IAGLR created a steering committee to oversee and help guide the project. Steering committee members and their respective titles and affiliations are listed in Appendix 1. Committee input was sought throughout the survey to ensure that the purpose, methods, and intended utility of the survey were in keeping with the committee members' expectations for the project. In this way the survey process was conducted in an open manner that was responsive to the committee's interests as the study progressed.

Establishing Rules of Inclusion

Many groups have a stake in Great Lakes issues. Our intent in this survey was to include in our sample those organizations that met the following four criteria:

- Offer an organizational, rather than personal view (i.e., executive director/president as spokesperson for the *organization*);
- A broad, Great Lakes basin-wide policy mandate;
- Traditional cultural ties to the basin;
- A role in Great Lakes policy-making, advising, or resource management.

Not all organizations in our sample fit nicely within these criteria, so some exceptions were made. The Sea Grant Programs of the various Great Lakes states are a case in point. We contacted a spokesperson for the Great Lakes Sea Grant Network, who explained that the Network does not exist as an administrative unit that can speak on behalf of individual Great Lakes state Sea Grant Programs. In other words, what we had initially conceived as one organizational contact ballooned into seven, all of which have a basin-wide stake but none of which can necessarily speak on behalf of the interests of any other state's Sea Grant program.

Identifying Potential Survey Participants

Potential survey participants were identified through numerous sources, including on-line searches, personal and telephone interviews, e-mail correspondence, and steering committee input. Identification information included the organization's name, its designated representative, and

her/his e-mail, phone number, and mailing address. Canadian members of the steering committee were primarily responsible for compiling the list of Canadian stakeholder groups, while the U.S. members were primarily responsible for compiling the U.S. list. The two lists were compiled mostly during February, though to ensure maximal organizational coverage some additional compilation continued through March, even after the survey had begun. The master list of stakeholder organizations was maintained by the IAGLR Webmaster, who also administered the on-line portion of the survey. The full list of stakeholder groups is provided in Appendix 2.

Designing the Survey Questionnaire

The survey questionnaire was designed with considerable input from the steering committee. The committee decided that an on-line survey would be the fastest and most effective means of gathering input during the relatively short time period preceding the IAGLR conference. Four areas in particular were identified as most relevant to IAGLR's science-policy project: (1) Highest-Priority Great Lakes Policy Issues, (2) Organizational Use of Scientific Information in Great Lakes Policy Development, (3) Organizational Information, and (4) Open-ended Comments on the Great Lakes Science-Policy Effort. The on-line questionnaire included both open- and closed-ended questions within each of these areas, and where relevant, it utilized ranking criteria and rating scales. It was pre-tested in late February among the IAGLR board and steering committee. Modifications were made based on feedback received from the pre-test. The final version of the on-line survey questionnaire is provided in Appendix 3.

Setting Survey Period

The initial survey period ran from March 5 through March 30; however, we extended the date to accommodate stakeholders that wanted to participate in the study but were unable for various reasons to respond within the allotted timeframe. Although the bulk of responses were received by the end of March, the final response was logged on April 16, 2001.

Contacting Participant Organizations

The survey was conducted online via the IAGLR web site. Stakeholders were invited to participate via an e-mail message from the IAGLR President, and directed to a web page. This invitation letter is provided in Appendix 4. The web page contained information about the survey, including purpose, method, utility, funding, timeline and informed consent (<http://www.iaglr.org/scipolicy/survey/about.php>), as well as a link to the project page (<http://www.iaglr.org/scipolicy/intro.php>) for further details. Participants then were prompted to proceed to the questionnaire (<http://www.iaglr.org/scipolicy/survey/survey.php>) via a link at the bottom of the page.

Data Collection

Once participants filled out the questionnaire and submitted their responses, the data were automatically sent to three different places:

- 1) A receipt e-mail to the participant to provide a record of his or her responses;

- 2) A notification e-mail to the IAGLR webmaster to let her know a survey was submitted. This was a duplicate of the e-mail sent to the participant and thus provided a handy backup of the data; and
- 3) A pipe-delimited ASCII file on the server. This file was then download via a password-protected web page and imported into a database for analysis.

Re-contacting Non-respondents

Commonly accepted survey standards suggest a five-week response period is considerably restrictive for survey participants and can affect the overall response rate. Consultation with colleagues at the Survey Research Center (SRC) of the University of Michigan's Institute for Social Research revealed that three to six months are more commonly allotted for their survey projects. Within that timeframe, follow-up is typically conducted at roughly monthly intervals among survey non-respondents to encourage their participation.

The relatively short timeframe of the IAGLR survey (four weeks) required that non-respondent follow-up be compressed into much shorter cycles. On average, stakeholders in the IAGLR survey were given 10 days to submit their survey responses, after which we sent a follow-up "reminder" letter to further encourage their participation had they not yet responded. That letter is provided as Appendix 5 to this report. Those non-respondents were given an additional 10 days to respond, after which we sent them the same reminder letter had they still not responded.

Non-response should not, in this case, be taken as an indicator of an organization's lack of interest in the science-policy effort. By nature of our rules of inclusion we necessarily attempted to contact the heads of the stakeholder organizations included in our sample. These are very busy people, many of whom are frequently out of their office on travel or other organizational business. Even with reminder letters, the four-week survey period simply did not provide adequate time for a reasoned response from each invited stakeholder. We received several comments from invited participants stating that they were deeply interested in the survey effort, but were unfortunately unable to respond within the allotted timeframe. For this reason we extended our survey response period through April 16. Steering committee members assisted the survey staff by making personal phone calls to the remaining non-respondents, informing them of the two-week extension and further encouraging their participation in the research.

3. DESCRIPTION OF SURVEY RESPONDENTS

One-hundred-and-fifty stakeholder organizations were invited to participate in the survey, and 65 responses were received, for an overall response rate of 43 percent. In general, response rates for uninvited bulk mailings, be they electronic or regular mail, tend to be the lowest among the various modes of survey research (e.g., e-mail, regular mail, telephone, personal interview). Consultation with colleagues at the Survey Research Center (SRC) of the University of Michigan's Institute for Social Research suggests that 15 – 20 percent is not uncommon for mail surveys, even with the standard three to six month survey timeframes. Although we would have preferred a 100 percent response to the IAGLR survey, the response rate obtained is respectable, particularly considering our relatively restrictive six-week survey period. More importantly, recent studies conducted by the SRC have shown that a survey response rate does not necessarily need to be high (for example, 90 – 100 percent) for the findings to be valid, provided the responses that are received are proportionally representative of the various strata included in the survey sample. In the IAGLR survey these strata correspond to the organizational categories identified in Appendix 6. As is noted below, the proportion of respondents to all those invited within each organizational category is fairly close to the overall percentage of responses, for most categories.

Survey respondents are distributed widely in the Great Lakes basin, on both sides of the international border. A substantial number represent binational organizations, such as the Great Lakes Fishery Commission, and the International Joint Commission (Table 1). There are also four native organizations (all multi-tribal resource management groups or coalitions); all respondents from native organizations were located in the United States.

Table 1: Country of Organization

Country of organization	Respondents
United States	33
Canada	17
Binational (e.g. GLFC, IJC)	11
Native	4

Respondents' organizations were classified in terms of ten categories. As Table 2 indicates, the largest number of respondents represent agencies and departments of the American federal government. Smaller numbers represent American states (including the Council of Great Lakes Governors, and agencies of the New York, Minnesota, Illinois, Pennsylvania, Ohio and Michigan state governments), environmental non-government organizations (such as Great Lakes United, the Great Lakes Sport Fishing Council, and the Canadian Environmental Law Association), organizations based in universities (including Sea Grant programs), Canadian federal agencies, industry (including individual companies, and collective entities such as the Council of Great Lakes Industries [2 responses], and the American Forest and Paper Association). Smaller numbers of respondents came from Ontario provincial agencies, native organizations, and "governance" organizations (the IJC, GLFC, International Association of Great Lakes and St. Lawrence Mayors, and Great Lakes Commission). Finally, three organizations did not fit within any category, and hence were categorized as "other".

Appendix 2 provides a list of all survey respondents, grouped within these types of organization.

Table 2: Respondents From Each Type of Organization

Type of Organization	Respondents
United States federal government	11
United States state governments	9
Environmental NGOs	9
Academic institutions	8
Canadian federal government	7
Industry	6
Canadian provincial government (Ontario)	4
Native organizations	4
Governance organizations	4
Other organizations	3

An important question is whether the responses are a fair sample of all those invited to participate in the survey. The overall response rate was 43% (65 of 150). As Table 3 indicates, approximately this rate was also achieved within most organizational categories. Two significant exceptions, however, are the Canadian federal government and Canadian provincial governments (primarily Ontario); in both cases, responses are significantly lower than the average. In contrast, the proportion of academic institutions and industry responding was significantly above average. There is, therefore, a measure of categorical bias in our data. However, this bias has likely had only a minor impact on which issues were identified as of highest priority, because (as is noted in the following section) the priority issues identified by respondents within each organizational category largely paralleled those identified by all respondents.

Table 3: Response Rate for Each Type of Organization, as Percentage of Total Invited

Type of Organization	Response rate
United States federal government	42%
United States state governments	41%
Environmental NGOs	38%
Academic institutions	67%
Canadian federal government	29%
Industry	54%
Canadian provincial government	29%
Native organizations	36%
Governance organizations	50%
Other organizations	43%

Respondents were asked to indicate, from a list, which term best describes their organization's role in Great Lakes policy. Responses to this question are indicated in Table 4.

Table 4: Organizational Role

Organizational Role	Respondents
Policy advisor	12
Policy advocate	12
Resource manager	9
Policymaker	9
Other	21
Did not respond	2

4. IDENTIFICATION OF PRIORITY ISSUES

Respondents were asked to identify and rank in order of importance, from their organization's perspective, the top three Great Lakes policy issues that would most benefit from a stronger connection to science. For the purpose of analysis, their responses were classified within a series of issue areas. The relative importance of each issue area was then evaluated by totaling the number of mentions of each, weighted by ranked importance (3 for most important, 2 for second most important, and 1 for third most important). As Table 5 indicates, water quality is considered the most important issue area, followed by water quantity and invasive species. Other issues areas, including development, governance, ecology, the use and roles of science, climate change, and fisheries, received fewer mentions. Each of these areas are discussed in more detail below.

Table 5: Issues Identified as Important by Respondents

Issue	Weighted mentions
Water quality	87
Water quantity	70
Invasive species	69
Development	34
Ecology	33 (16 mentions)
Governance	33 (14 mentions)
Use/role of science	28
Climate change	17
Fisheries	11

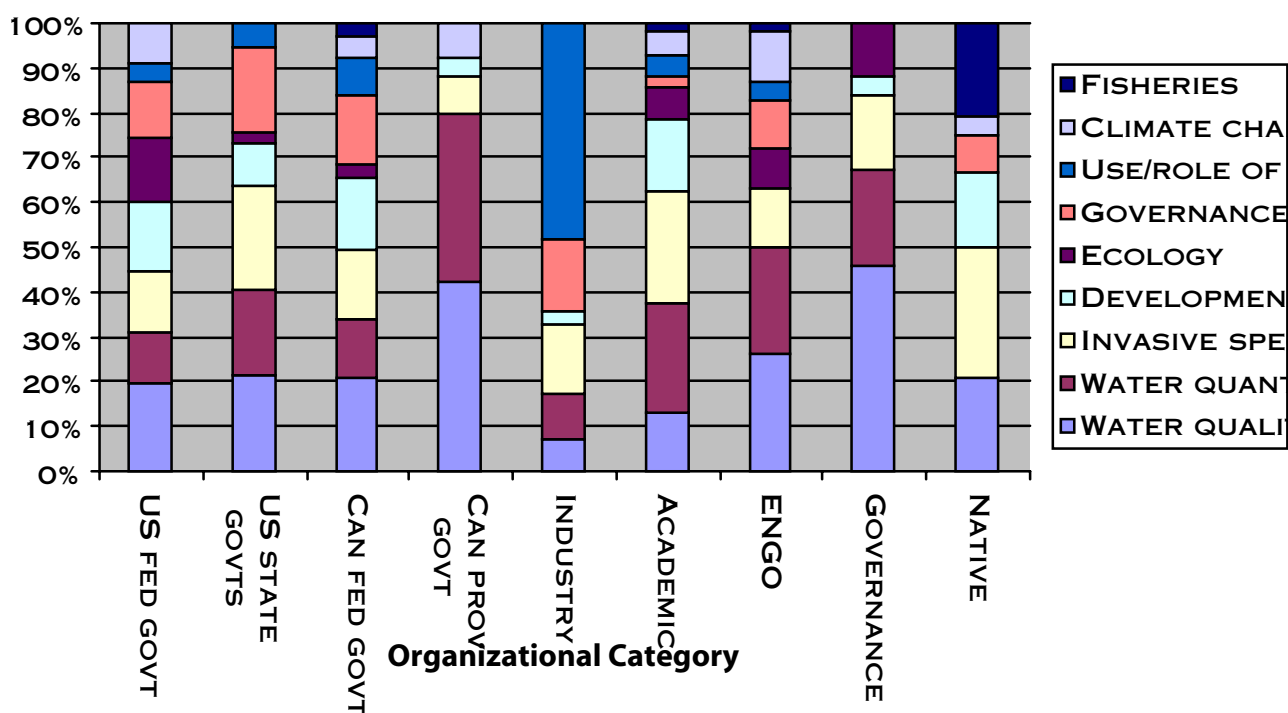
To better understand stakeholder priorities, it is helpful to relate priority issue areas to the categories of organizations surveyed. This is done on Figure 1, which indicates the relative importance of each issue for each category of organization.

Analysis of the rankings of priority issues across organizational categories indicates that the ranking of issue areas across all organizations is to a large extent paralleled by the rankings within specific categories. In particular, the three areas of highest priority (water quality, water quantity, and invasive species) also tend to dominate within each organizational type. This, of course, is not surprising: these three areas have been of perennial concern within the Great Lakes region (see, for example, GLC 2001). However, there are a few exceptions. These include:

- i) Industry respondents identified the use or role of science as a dominant concern;
- ii) American federal government agencies were less likely to identify water quantity as a major concern;
- iii) Respondents from Native organizations expressed more concern about fisheries.

These exceptions are discussed below, in the sections devoted to each of these issue areas.

Figure 1: Priority issues by organizational category



Specific Issue Areas

Besides being asked to identify three Great Lakes policy issues in order of priority, respondents were also asked the following questions: “Why is this issue so important?”, and “What two key questions does your organization have about this issue?” In this section, responses to these questions are drawn on in order to describe each issue in more detail. Four questions are addressed:

- i) **Who is concerned about this issue?** This question is discussed in terms of the organizational types of respondents.
- ii) **Why is this issue important?** This question is discussed on the basis of respondents’ explanations regarding the importance of this issue.
- iii) **What is the nature of this concern?** That is, how can this issue area be defined more precisely?
- iv) **What questions require answers regarding this area?**

To capture the richness of the details provided by each respondent regarding each priority issue, including why each issue is considered important, all relevant responses are listed in Appendix 6.

Water quality

Who is concerned about this issue?

Water quality was identified as a significant issue by respondents representing most types of organizations. Table 6 indicates the importance of this issue within various organizational types. Weighted mentions of water quality are expressed as a percentage of weighted mentions of all issue areas. The table indicates that governance agencies, provincial agencies, and “other” agencies were most likely to mention water quality. In contrast, academic and industry respondents were less likely to mention water quality.

Table 6: Relative Importance of Water Quality by Organizational Type

Water quality	Frequency of mention / total mentions
Governance	46%
Can provincial govt	42%
Other	40%
ENGO	26%
US fed govt	21%
Can fed govt	21%
Native	20%
US state govt	20%
Academic	13%
Industry	6%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Implementing the precautionary principle in general and phasing out PBTs in particular:

The Great Lakes Water Quality Agreement calls for the phase out and elimination of PBTs. Not only has this not been done, but we are likely introducing new PBTs every year. We are rapidly discovering new contaminants that are persistent and bioaccumulative, and that have, in fact, already accumulated in people. We don't know what the impacts of all of these contaminants will be, but we are finding evidence of health and developmental effects for many pollutants, particularly in our children (excerpt).

We need a simple basin-based compilation of human health indicators:

We don't have it, and yet we are aware of many troubling things: a record number of beach closings in some areas last summer, fish advisories, drinking water alerts or crises in some communities, cancer clusters, asthma/respiratory clusters, other rare disease clusters, numbers of communities who have changed their drinking water supply, etc. When we try to make policy recommendations related to these issues, we have no basin-wide statistics of analyses of any of this.

Pollution from land use:

Sprawl and development in general are growing in the Great Lakes. Current trends in land use practices point to severe increases in pollution and may offset gains in remediation of existing contaminated areas.

What is the nature of this concern?

Within the broad area of water quality, a wide range of issues were identified. This variety can be understood, in part, in terms of ecosystem components, as represented in Table 7:

Table 7: Ecosystem Components within Water Quality

Ecosystem component	Frequency of mention
Water	21
Humans	9
Biota	8
Atmosphere	5
Land	4
Sediment	4
None specified	6

As Table 7 indicates, water quality is perceived not only in terms of water, but in terms of other ecosystem components as well. Human health concerns, impacts on other biota (including fish), and the input of contaminants via the atmosphere, from land-based activities, or in contaminated sediments, were also noted.

Most often, specific pollutants were not mentioned; instead, respondents commonly noted concern regarding “pollutants”, or “contaminants”. However, some specific substances were mentioned. These included both long-standing concerns (such as nutrients, sediments, and human wastes from vessels), and emerging concerns (such as airborne mercury, dioxin, and pharmaceuticals).

What questions require answers regarding water quality?

Many questions regarding this issue were provided by respondents. These can be placed within five categories, as indicated below, with examples of questions.

In this and subsequent sections in which questions regarding other issues are discussed, these example questions (provided verbatim from the surveys) were chosen from amongst all questions provided because they expressed with greatest economy and clarity the concept or principle of interest.

1) Understanding existing problems.

- How much mercury and other contaminants is reaching tribal people through their subsistence diet?
- What are the extent and magnitude of the effects of current land use practices on human and ecosystem health?

2) Identifying emerging problems.

- What is a screening procedure that can be used to determine whether proposed chemicals or the potential byproducts of a proposed industrial or manufacturing process are persistent, bioaccumulative, or toxic?
- Can existing indexing systems (e.g. for persistence, toxicity, bioaccumulation potential) be combined with existing or soon-to-be-collected data to indicate newer chemicals of concern that should become priorities for policy action?

3) Setting priorities.

- What changes in urban land use practices will provide the greatest reductions in pollution?
- What is the significance of the problem, if any, regarding human wastes (treated or untreated) being emitted from vessels?

4) Measuring effectiveness of policy.

- How to measure the effects of reducing sediment and nutrient loadings to waterways?
- Given the levels of contaminants and rate of newer and cleaner sediments to the system, how long will it take for natural recovery of the entire ecosystem to occur?

5) Improving policy.

- How to improve the process of conservation planning and management practice implementation to alleviate critical problem areas?
- How can brownfields redevelopment and greenfields preservation initiatives be developed and linked to improve water quality through informed, responsible land use?

Together, these questions imply a diversity of roles for scientific information in the managing of water quality in the Great Lakes region.

Water quantityWho is concerned about water quantity?

As Table 8 indicates, while at least some concern regarding water quantity was expressed by respondents from most organizational types, those from Canadian provincial agencies, “other”, academic, and environmental organizations were especially likely to do so. American federal government agencies, industry, and native organizations were less likely to mention this issue.

Table 8: Relative Importance of Water Quantity by Organizational Type

Water quantity	Frequency of mention / total mentions
CN prov govt	38%
Other	25%
Academic	24%
ENGO	24%
Governance	21%
US state govt	18%
Can fed govt	13%
US fed govt	11%
Industry	10%
Native	4%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Water supply and use in the Great Lakes Basin at a watershed level

With the impact of climate change we, at the watershed level, need to be able to predict the appropriate water management actions (water budget modeling) which will take into account droughts, flash flooding and reduced base flow.

Water levels - Establish a process and criteria for approving water withdrawals

The draft Annex 2001 issued by the Council of Great Lakes Governors has spurred many public comments regarding the decision-making process for allowing withdrawals/diversions from the Great Lakes Basin. Although New York State currently has a permitting process for such withdrawals, more scientific data is needed to evaluate impacts on a multi-scale basis.

Science to support laws that protect ecosystem integrity and prevent export and diversion

A lot of lip service is being given to the need to protect Great Lakes water resources over the long term from diversions and bulk export. These strategies all call for some sustainability strategies but are very thin on concrete conservation practices that could go a long way to demonstrate that Great Lakes communities are serious about doing their part to prepare for a water short world. These strategies could assist greatly in any trade challenges which could be bought to claim access to GL waters. The current Annex 2001 proposal made by the GL governors is not supported by the Province of Ontario and the Canadian governments because it is too vague on tangible conservation and protection standards. All lawyers who have looked at trade and water say laws based in sound science should be passed that fulfill the states and provinces right to protect the integrity of their water resources. Just how do we come up with sound science in time to see these protections in place within 21/2 years?

What is the nature of this concern?

Mention of water quantity was especially motivated by concerns regarding water diversion or export. As Table 9 indicates, other aspects of this issue area were mentioned much less frequently.

Table 9: Water Quantity Issues

Water quantity issues	Frequency
Diversion/water export	17
Relation between water quality & quantity	4
Climate change implications	3
Lake levels	3
Regulating water use	2
Ground water	2
Intra-basin water transfer	1

What questions require answers regarding water quantity?

Questions regarding water quantity can be placed within three categories. Many of these questions, particularly those relating to water export, relate less to specifically scientific issues, than to political or legal matters.

1) Measuring current resources and predicting the state of future resources

- How much water (surface and ground) is available for use in the watershed and how much is currently being used in the watershed?
- What anticipated impacts will climate change have on our water supply?

2) Assessing the environmental impacts of water diversion

- How little is too little GL water before there is loss of species and biodiversity and disruption of the food web?
- What is considered a "sustainable" amount of water for the Great Lakes - especially the lower basin (Lake Erie and Lake Ontario) and over what period of time?

3) Policy for protecting Great Lakes water

- Can an anti-diversion law or policy accommodate water transfers to communities that are astride the hydrologic boundary?
- How can the Great Lakes stakeholders get Congress to recognize the importance of keeping Great Lakes water in the Great Lakes basin?

Invasive species

Who is concerned about this issue?

As is indicated in Table 10, invasive species were identified as a significant issue by representatives of most organizational types, particularly native organizations, academics and state governments.

Table 10: Relative Importance of Invasive Species by Organizational Type

Invasive species	Frequency of mention / total mentions
Native	28%
Academic	25%
US state govt	22%
Other	20%
Governance	17%
Can fed govt	16%
Industry	16%
US fed govt	15%
ENGO	13%
Can prov govt	8%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Continued invasion by non-native nuisance species

The disruption to the Great Lakes Ecosystem, both water and land has been devastating. The science has clearly shown the nature of the problem, yet the invasions continue. The policies and procedures in place are not working, since invasions continue.

Aquatic nuisance species and ballast water

One-hundred-and-sixty aquatic nuisance species(exotics) in GL basin. More on way, 17 from Ponto-Caspian Basin alone (Ricciardi and Rasmussen). Ballast water discharges, especially from NOBOB ships(No Ballast On Board) which are not subject to high seas exchange requirements, are still primary vector. Exotics present devastating challenges to GL ecosystem, especially fisheries and entire food web. May accelerate bio-accumulation of persistent, bio-accumulative toxics, too.

Continued introduction of invasive/non-native species which out compete endemic species.

These non-native species have replaced/displaced indigenous species that have existed here for thousands of years and are disrupting the lakes' ecosystems. The ecological risks posed by invading species directly translate to the disruption of the natural cycle upon which many species, especially humans, depend such as fishing, hunting, and gathering.

What is the nature of this concern?

Within the issue of invasive species, several more specific aspects or concerns were often mentioned. The frequency of these mentions is indicated in Table 11. As these data indicate, concern regarding invasive species is dominated by:

- i) Concern about the overall ecological impacts of invasive species. In contrast, concerns about their economic impact were mentioned much less frequently; and,
- ii) The perception that ballast water is the chief means of entry of these species into the Great Lakes.

Table 11: Invasive Species Issues

Invasive species issue	Frequency of mention
General ecological impacts	24
Ballast water	11
Economic impacts	5
General – no mention of ecology	3
Intentional stocking	2
Other modes of entry	1

Responses provided only limited insight into which species are of greatest concern. While, as Table 12 indicates, some species were mentioned (especially the zebra mussel), the great majority of respondents (27 of 36) expressing concern regarding invasive species did not mention any specific species. This is consistent with the widespread view, expressed in respondents' comments, that invasive species are a more general, ecosystem-level phenomena, not limited to the impacts of, or impacts on, any one species.

Table 12: Mentions of Specific Invasive Species

Invasive species	Frequency of mention
Zebra mussel	6
Round gobies	2
Purple loosestrife	2
Quagga	1
Zooplankton	1
Sea lamprey	1
Spotted knapweed	1
Carp	1
Alewives	1
European starling	1

Finally, comments indicated a widespread view that the problem of invasive species is understood, in scientific terms. What is lacking are effective controls on these species. As one respondent noted, "The disruption to the Great Lakes Ecosystem, both water and land has been devastating. The science has clearly shown the nature of the problem, yet the invasions continue. The policies and procedures in place are not working, since invasions continue."

What questions require answers regarding invasive species?

Questions regarding invasive species can be placed within four categories. They indicate the complexity of this issue, involving both the prevention of new introductions, and the management of those already present. They also indicate how solutions to this problem are understood by some respondents as being primarily technical (e.g. developing effective biocides for the elimination of organisms in ballast water); but by other respondents as requiring legal or political innovation.

1) Preventing, through technical means, new invasive species introductions.

- How do we better detect and eliminate non-native biota arriving in the basin through commerce?
- Are there effective biocides which can be deployed safely in the short term, given the pace of technology is so slow?

2) Preventing, through legal or political means, new invasive species introductions.

- What legal steps can be taken within the framework of national and international law to prevent the introduction of non-native invasive species?
- Why haven't our congressional leaders and USEPA bureaucrats dealt with this issue in a meaningful manner under the Clean Water Act, and/or with new federal mandates on ballast dumping and NOBOBs; and why can't state initiatives get off the ground floor and enacted to deal effectively with this issue?

3) Controlling or limiting the impact of species already introduced into the basin.

- How can present invasive species be brought under control?
- What (reactive) corrective measure are available to control zebra mussels?

4) Understanding the impact of invasive species.

- What is the impact of non-native species on native, especially endangered species?
- Can existing species adequately adapt to survive the continued invasion of ANS?

Development

This is a diverse issue area, encompassing several aspects of the environmental impacts of economic development in the Great Lakes region.

Who is concerned about this issue?

As Table 13 indicates, concerns regarding this issue are most frequently encountered by respondents representing both federal governments, academic organizations, and native groups.

Table 13: Relative Importance of Development by Organizational Type

Development	Frequency of mention / total mentions
US fed govt	17%
Academic	16%
Can fed govt	16%
Native	16%
US state govt	9%
Can prov govt	4%
Governance	4%
Industry	3%
ENGO	0%
Other	0%

What is the nature of this concern?

As Table 14 indicates, the most significant development-related concern identified by respondents was the impact of land-based development, particularly in urban areas, on the Great Lakes ecosystem. One comment can serve to indicate the range of concerns mentioned: "Loss of habitat and biodiversity is threatened by continued urban/suburban growth as well as greenfields development at the expense of brownfield redevelopment. Nonpoint source pollution is also part of the threat due to many activities on the land and the increase in impervious surfaces. Both the "sprawl" aspect and the nonpoint source pollution aspect (diffuse runoff) are still not adequately addressed by policy, law or practice throughout the region."

Smaller numbers of respondents mentioned other aspects of development, including the impacts of boating or shipping, and of dredging.

Table 14: Development Issues

Development issue	Frequency of mention
Effects of land-based development	11
Impacts of boating/shipping	4
Dredging	2
Economic/ecological relations	1
Economic development	2

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Economic/environmental sustainability;

Smart growth issues have impacts from local to federal level; imperative to economic growth and environmental enhancement/protection; expanding scientific understanding of function, biodiversity and economic importance of Great Lakes is imperative.

Shoreline and watershed development

Has a direct impact on chemical, physical, and biological characteristics of the Lakes. Development is integrally related to non-point pollution issues. Existing and future land uses in the basin will dictate to large extent the magnitude of the problems.

Consistent dredged material management requirements.

There are inconsistent requirements for dredged material management between the states on the Great Lakes. In addition there are inconsistent requirements between in-lake and upland disposal of dredged material. While there may be scientific justification of differing requirements in some cases, it appears that oftentimes science may not be a consideration. Inconsistencies impact on ability to provide regional consistency for commercial and recreational navigation users and the customers they serve, and economically feasible as well as environmentally acceptable alternatives. The Great Lakes Regional Dredging Team has ongoing work efforts on this issue also.

What questions require answers regarding development?

Questions relating to development can be placed within four categories. As with other issues (such as invasive species) they illustrate how this issue is seen as one requiring both scientific and policy solutions.

1) Assessing the impacts of development.

- How will this pattern of settlement affect ecosystems of Northern Lake Huron and Lake Superior, as well as inland lakes?
- How is the development in the watershed affecting the availability of fish, wildlife, wild rice and other items for tribal subsistence use?

2) Defining the relation between environmental priorities and development.

- What are the quantifiable relationships between shoreline and watershed development and nearshore ecosystems indicators?
- How do you perform natural capital valuations?

3) Identifying appropriate policy responses to development.

- How can the Tribes, states, counties, cities, townships, and villages adopt standards that limit the amount and type of construction in ecological sensitive and important areas?
- How can communities be convinced of the importance of preventing rampant growth, preserving open space and planning for transportation and other infrastructure needs?

4) Improving environmental management techniques.

- Can we better manage dredging and beach nourishment efforts to provide more effective projects reducing costs and improving environment?
- Which mitigation and restoration techniques are most effective at minimizing the negative impacts of development on natural systems?

Use/role of science

Several respondents chose not only to mention various specific environmental issues or priorities, but also identified some more general aspects of science, and its contribution to various aspects of decision-making, as matters of concern.

Who is concerned about this issue?

As Table 15 indicates, industry representatives dominated among respondents expressing concern regarding the use and roles of science. A few respondents among other types of organizations also mentioned this issue area.

Table 15: Relative Importance of Use/Role of Science by Organizational Type

Use/role of science	Frequency of mention / total mentions
Industry	48%
Can fed govt	8%
US state govt	6%
Academic	5%
ENGO	4%
US fed govt	4%
Can prov govt	0%
Native	0%
Governance	0%
Other	0%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Use of sound or peer reviewed science including good data interpretation techniques and statistics

Some work is conducted and analysis is interpreted on limited scientific data. This may be through extrapolation of data from one area to another without validation. Accumulations and decays are based on simple scientific tools such as linear relations when in fact they are complex interacting and non linear. Also confounding influences (sometimes of natural origin) are not taken into account.

Better interpretation of environmental data

Society has expended extensive resources on cleaning up the Great Lakes and will continue to do so. These resources must be applied where they will do the most good. A correct interpretation of how well we are doing is critical to making future policy choices. Incorrect interpretation on trends will result in poor decision making.

Implement the findings of past funded research on water and biotic quality

The public needs to see that past funded research is put to good use. The resources need attention now, to prevent degradation.

What is the nature of this concern?

Responses addressing this issue area generally addressed one of four themes. These themes can be summarized as the following (Table 16):

- i) That scientific results and conclusions (particularly those relating to environmental policies or controversies) be interpreted and reviewed appropriately, through peer review or other means;
- ii) That scientific research be supported, so that it is able to provide an effective basis for decisions;
- iii) That research results, when available, be applied;
- iv) That science or scientific advice can be politically motivated.

Table 16: Frequency of Themes within the Science Use/Role Issue Area

Theme	Frequency of mention
Appropriate interpretation of results, conclusions	6
Support for science	2
Application of results	2
Political motivation of science	1

It is also worth noting a separate comment made by one respondent, regarding the extent to which action can be justified on the basis of less than complete scientific understanding of an issue:

“Most importantly, do not let the lack of a complete and thorough understanding of the science behind a problem delay policy responses to that problem. We will never completely understand most of these issues, and so we must act in the face of uncertainty. That is what iterative management is all about -- taking action and adjusting the actions as conditions change. Some constituents will always call for further study, but we cannot ever know or understand everything in such a complex system. We must act based on what we know now.”

What questions require answers regarding the use and roles of science?

Questions posed regarding science related to various aspects of the relationship between science and policy. They can be placed within four themes:

1) Appropriate communication and interpretation of scientific results

- How can those utilizing data be made aware that interpretations are not necessarily absolute and that often data is incomplete or inadequately interpreted from a statistical and scientific view?
- How can the need to use proper data presentation protocols be most effectively brought to the science community's attention?

2) Application of available research results

- Why is new research proposed, when we have not implemented the results of past research, such as in the case of Areas of Concern ?
- Can someone demonstrate why and how past research is not sufficient to justify implementation activity or do we have a disconnect between the research done and the potential implementing organizations?

3) Ensuring a sound scientific basis for policy

- How does one construct a policy framework that allows new findings - after peer review - to be integrated into existing priorities?
- What process can be put in place to assure that environmental anomalies will be investigated and reported on through use of scientific principals?
- How can scientists be encouraged to seek peer review before releasing firm “conclusions” regarding their observations so that their work can be viewed as more credible?

4) Ensuring that research is directed towards policy priorities

- How to develop a more effective linkage between research and applied conservation on the land?
- How to fund the research necessary to keep creating opportunities for improving conservation technology?

Ecology

The issue “ecology” refers to concerns expressed regarding the status of ecosystems within the Great Lakes. This includes mentions of Great Lakes ecosystem health or integrity, as well as concerns relating to habitat protection or restoration.

Who is concerned about this issue?

As Table 17 indicates, the American federal government and governance agencies are the types of organizations most likely to identify ecology as a priority issue.

Table 17: Relative Importance of Ecology by Organizational Type

Organizational type	Frequency of mention / total mentions
US fed govt	14%
Governance	12%
ENGO	9%
Academic	7%
Can fed govt	3%
US state govt	2%
Can prov govt	0%
Native	0%
Industry	0%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

Increase mechanisms (especially incentives) for implementation of ecosystem-level management

Ecosystems in the Great Lakes region occur at multiple scales. Regardless of scale, most ecosystems share certain properties: they include a complex interaction between biotic and abiotic factors, are made even more complex when humans and human activities are considered part of the system. Therefore, at any scale, ecosystem-level management needs to consider the complex interactions between land, water, and biota, both human and non-human. Unfortunately, the spatial and temporal complexity associated with this kind of planning effort often precludes any attempts from taking into consideration the interactions among natural resources (e.g. forests, streams, wetlands, multiple taxonomic groups, wide-ranging species) in management planning. As a result, resource management is often uncoordinated and resource-specific; it does not adequately address the myriad interactions among our natural resources and the potential, indirect impacts that individual management activities may have.

Conservation of Habitat

Losses of physical habitat critical to fish and other aquatic organisms continue in the Great Lakes even though development of Great Lakes shorelines and river flood plains is regulated by governments. Much aquatic habitat, just like the fish that depended on it, vanished in the 1800s before it was inventoried or its value understood. Clearly, those aquatic habitats whose supply has been most diminished are now all the more valuable owing to their scarcity. Problems of protection and rehabilitation appear nearly insurmountable because of a diffuse regulatory structure and an absence of reporting loss in relation to supply...

What is the nature of this concern?

Responses addressing this issue area generally addressed one of three themes. These themes can be summarized as the following (Table 18):

- i) Maintenance of Great Lakes ecosystem health or integrity;
- ii) Conservation of habitat;
- iii) Ecosystem restoration.

Table 18: Frequency of Themes within the Ecology Issue Area

Theme	Frequency of mention
Ecosystem health/integrity	8
Habitat conservation	4
Ecosystem restoration	4

What questions require answers regarding ecology?

Questions relating to Great Lakes ecology can be placed within six types. These are indicated below, with example questions relating to each. The two types most often provided related to setting priorities, and coordinating activities.

1) Setting priorities for Great Lakes ecological issues

- What are the most important aquatic conservation projects and why?
- What is a scientifically defensible means by which to classify and inventory Great Lakes habitats?
- If a policy goal were to establish a sustainable fishery of native Great Lakes species, where would be the best place to begin in terms of existing habitat and species?
- What are the most detrimental in-place or existing stresses on the system due to historic events? How can they most efficiently be rectified?
- Does managing the ecosystem to a preferred state truly represent a healthy, naturally evolving environment or simply one artificially confined to a single evolutionary stage?

2) Coordination of joint efforts

- How can we integrate our response to specific problems so that it is consistent with all of our ecosystem restoration objectives (not solve one problem while making another worse)?
- What tools and knowledge are necessary to develop coordinated ecosystem plans that adequately address the complex interactions within ecosystems in the Great Lakes region?
- Assuming that we have the technology to map and track changes in the landscape, what kind of incentives can be provided to foster cooperative work, given legal and other constraints, to achieve a shared landscape vision?

3) Effective strategies for managing Great Lakes ecosystems

- What steps are necessary and permissible to prevent additional stream and lake degradation and to improve the water quality and biota in the great lakes and their tributaries?
- What is necessary to rebuild the waste water systems, including storm water systems, to achieve and maintain full compliance. This includes the updating of existing aging systems and the construction of new systems. How is this to be financed on a long-term basis?

4) Measuring progress.

- What are the key social and biological indicators of ecological integrity?

5) Identifying problems.

- Is wetlands loss the major reason for the past several years of Type E botulism outbreaks that have killed millions of Great Lakes waterfowl?

6) Communication.

- How can the agencies make their efforts more relevant to the average great lakes citizen?

Governance

The issue “governance” refers to a wide range of concerns, relating to such matters as cooperation among jurisdictions, and the setting or revising of policies, that do not relate to any specific environmental issues.

Who is concerned about this issue?

As Table 19 indicates, American state governments, the Canadian federal government, and industry are the types of organizations most likely to identify governance as a priority issue.

Table 19: Relative Importance of Governance by Organizational Type

Ecology	Frequency of mention / total mentions
US state govt	18%
Can fed govt	16%
Industry	16%
US fed govt	13%
ENGO	11%
Native	8%
Academic	2%
Governance	0%
Can prov govt	0%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest priority, are provided below.

The absence of a recognized process for setting Sustainable Development priorities

The current helter-skelter approach (excepting SOLEC) commits large amounts of resources and effort, especially toward environmental objectives, without the ability to assess relative risks/returns.

Jurisdiction over Great Lakes water

States have conducted a number of activities that have compromised the quality of Lake Superior waters. They are now considering allowing water to be removed from the Great Lakes by "contractors" and other states. These decisions are being made without input from or regard to Indian tribes in the Great Lakes system. Indian tribes should have the same rights, or greater, than states to decide how the waters of the Great Lakes should be used. Many tribes near the Great Lakes use them for subsistence fishing

Renewal of the Canada/Ontario Agreement

Because the COA, especially its most recent (and lapsed) version, stands, albeit imperfectly, as the mechanism that has so far achieved some really impressive results in protecting, restoring the Great Lakes and improving public understanding of/involvement with Great Lakes water quality and ecosystem health.

What is the nature of this concern?

A wide range of concerns were expressed by respondents. They relate to diverse issues, such as procedures for renewing and revising policies in response to changing conditions, cooperation across jurisdictions, and native involvement in policy (Table 20).

Table 20: Frequency of Themes within the Governance Issue Area

Theme	Frequency of mention
Procedures for renewing/revising policies	3
Multi-jurisdictional cooperation on regulations and governance	3
Native involvement in policy	2
Boating safety	2
Need to set policy priorities	1
Better water use data	1
Distinguishing anthropogenic and natural environmental impacts	1
Cultural traditions	1

In addition to these concerns, in a separate comment one respondent argued in some detail for the need for a greater emphasis on economic analysis as a component of governance:

“Given the history of environmental policy and law, we are at the point where economic analysis must be given a greater share of financial support. This is important to justify to many constituencies the next level of, say, environmental control or cleanup or protection. Second, it will aid us in focusing on the most cost-effective means. Third, it will help us develop incentive-based approaches which will more likely be accepted than prescriptive ones. Fourth, it will encourage full economic valuation of natural resources or "nature's services" rather than just compliance costs, thus balancing the cost-benefit equation more equitably.”

What questions require answers regarding governance?

Questions relating to governance can be understood in terms of four themes, of which means of enhancing cooperation was the most frequently noted. These are indicated below, with examples of questions.

Enhancing cooperation

- How do we cut through bureaucratic red tape to make cooperative efforts simple?
- Will the Lake Superior Lakewide Management Plan (and its associated processes) provide the framework for protecting and restoring the ecosystem(s) of Lake Superior? Does the Plan (and its associated processes) provide the framework for recognizing the Tribes' sovereignty over their territory and natural resources, and integrate Tribes as co-equal governmental partners?
- How can state enforcement agencies work together to minimize the negative impact on recreational boaters and fishermen? How can we work to standardize regulations?
- Can agreements of various lakes groups be more binding on govts, industry and the public regardless of borders?
- How to get the necessary link between social science research and physical research to educate partners about the need for all partners at all levels to work together effectively?
- How to develop policy research to address the needs for increased local, state, and federal support for conservation?
- How should we be communicating scientifically supported conclusions to all stakeholders and the public?
- How can a state governor unilaterally make decisions about the ultimate uses of Great Lakes waters?

Encouraging diversity in Great Lakes policy

- What is the best way to include First Nations in the Great Lakes policy development?
- Can the development of Great Lakes policy incorporate First Nations Traditional and local knowledge?
- How can we incorporate the cultural traditions of western NY, western PA, and Ontario in a meaningful way?
- How can regional policy be developed that does not severely impact local cultural traditions in the region?

Setting priorities

- Are there measurements that can be made to show what would benefit most from cooperative federal/provincial action on the Great Lakes?
- What changes in human behavior are most important to ensure the restoration and protection of ecosystem health? Who has responsibility and authority to cause those changes?
- How do we ensure scientific approaches - including peer review, proper data trend analysis and representation, etc. - are utilized in determining priorities?
- Will the public and the scientific community accept the less rigorous option if a detailed surveillance and monitoring plan is implemented to evaluate progress? Is the less onerous option necessary to maintain momentum in the RAP communities throughout the basin?

Understanding issues

- How can science answer questions about the long-term impacts of removing large quantities water from the Great Lakes watershed?
- How do we ensure that abnormalities or variances from the ANTICIPATED norm are looked into with a scientific approach, rather than jumping to the easiest conclusion based on the limited data available?
- What can be done to educate the media and others to encourage them to present a fair balance of the possible causes till the facts are available.

Climate change

Who is concerned about this issue?

As Table 21 indicates, environmental organizations and American federal government agencies are the types of organizations most likely to identify climate change as a priority issue.

Table 21: Relative Importance of Climate Change by Organizational Type

Organizational type	Frequency of mention / total mentions
ENGO	11%
US fed govt	9%
Can prov govt	8%
Academic	5%
Can fed govt	5%
Native	4%
Governance	0%
US state govt	0%
Industry	0%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest or third highest priority, are provided below.

Regional impacts of climate change

Anthropogenic inputs appear to be having an influence on regional temperatures and precipitation already and these effects will certainly increase in the future. Concerns about water resources and lake ecology clearly need to be incorporated into global, as well as regional policy.

Lake water levels and climate change

The influence of lake levels has important ecological and economic ramifications across the Great Lakes Basin and yet defining these ecological and economic ramifications is still in its infancy. Federal, regional, state, provincial, and tribal organizations are struggling to identify the appropriate approach to this complicated issue.

What is the nature of this concern?

Nine respondents noted climate change as either their first, second, or third highest priority issue. Of these, six specifically mentioned the potential impact of climate change on lake levels, or on availability of the resource. This indicates that the climate change issue and the water quantity issue are closely associated.

What questions require answers regarding climate change?

Questions relating to climate change can be understood in terms of two themes: prediction of future climate change and its impacts; and development of policy responses. These themes were addressed by ten and nine questions, respectively. Examples of some questions are provided below.

Prediction of the future climate and impacts

- How will predicted future climates impact lake levels?
- What effect will increased temperature have on Great Lakes ecology?
- Who is doing modeling on the effects of climate change on the Lakes? Anyone? No one? Shouldn't everyone be doing this?
- To what extent can examples of past climate change provide analogues of future conditions, and information about hydrological system thresholds, such as shoreline displacement through declining lake levels, and significantly reduced lake outflows?

Development of policy for climate change

- What policy initiatives are being enacted to deal with the reality that climate change is going to have a measurable impact on the ecosystem?
- How can we get science on causes into lake level changes into policy and law?
- How exclusive should water withdrawal legislation and other rule making be with respect to the real threats to the ecology and economics of the basin?

Fisheries

Who is concerned about this issue?

As Table 22 indicates, according to this survey it is primarily native organizations that identify fisheries as a priority issue.

Table 22: Relative Importance of Fisheries by Organizational Type

Organizational type	Frequency of mention / total mentions
Native	20%
Can prov govt	3%
Can fed govt	3%
Academic	2%
ENGO	2%
US fed govt	0%
Governance	0%
US state govt	0%
Industry	0%

Why is this issue important?

To illustrate some aspects of this issue, a few examples of responses to the question, “Why is this issue important?” from among those who listed this as their highest, second highest, or third highest priority, are provided below.

Implementation of the Joint Strategic Great Lakes Fishery Management Plan

This relates to Indian Tribes' treaty-guaranteed fishing rights and the recognition of Tribes as co-equal governmental partners in the regulation and management of fisheries that are subject to those rights.

Maintaining fish stocks and the recreational base for the region

The Great Lakes are one of the major economic resources of the region and result in a large influx of money from other regions that clearly bolsters the economy of states like Michigan.

Protection of Aboriginal fishing rights

For the preservation of traditional uses, community sustenance and commercial opportunities for First Nations.

What is the nature of this concern?

Two themes predominated in the comments of the six respondents who listed fisheries as a priority issue. One theme was the protection or maintenance of fish stocks (4 responses); the second was the protection of native fishing rights (2 responses). In addition, in a separate comment, one respondent expressed concerns regarding the links between the fishing community and scientists:

“There is a distinct disconnect between the traditional sportfishing community - grass roots movements - and Science. The science community has not served the angling community well, and it probably surfaced with the advent of the two-tiered action levels generated for fish consumption advisories. To exacerbate the situation, health experts, the media and our local paper's food section are constantly reminding us of the benefits of eating fish. Their comments are up front, not buried in some rhetorically laden piece of yellow journalism.”

What questions require answers regarding fisheries?

Questions relating to fisheries addressed two themes: effective fisheries management (four questions), and protection of native fishing rights. Some representative examples of questions addressing either theme are provided below.

Effective fisheries management

- Are we maximizing our efforts to sustain fish plantings via cooperation with federal and state authorities as well as Indian tribes to insure the long term maintenance of the fishery for both sport and commercial purposes?
- Why do we continue to use commercial harvesting gear that dates back to pre-biblical times, when other, more contemporary type is more selective and less destructive and less harmful to the resource? When will we learn the lessons history has to offer us?

Protecting native fishing rights

- Does the Plan recognize the Tribes' sovereignty over their treaty rights, and provide a natural resources management framework that integrates the Tribes as co-equal governmental partners?
- What is being done to protect aboriginal fishing rights? Can First Nations be involved in these efforts?

5. SOURCES OF INFORMATION

The following questions were asked of respondents:

- Does your organization currently use scientific information in formulating/implementing its Great Lakes policies?
- If “no” above, does your organization plan to use scientific information in formulating/implementing its Great Lakes policies in the future?
- How often does or will your organization use scientific information in formulating and/or implementing its Great Lakes policies?
- We are interested in learning how valuable the following sources of scientific information are to your organization. Please rate each in terms of its value in formulating and/or implementing your Great Lakes policies. (These sources are listed in Table 18).

Thus, these questions asked respondents to provide information regarding their organization’s use of science, and their sources of scientific information.

As Table 23 indicates, most respondents (96% of those answering yes or no) stated that they now use science. These data are corroborated by those provided in Table 24, which indicate that 85% of respondents stated that they use science “frequently” or “always”.

Table 23: Use of Science by Respondents

Use of science	Responses
Yes	51
No	2
Don’t know	1
Not applicable	10

Table 24: How Often Do You Use Science?

Frequency of use	Responses
Always	26
Frequently	24
Seldom	6
Never	3

Respondents were asked to identify the importance of various sources of scientific information. The results were then assigned weighted values (Low: 1, Medium: 2, High: 3; theoretical maximum total for each source is 192). As Table 25 indicates, all of these sources are used to some extent; however, the world wide web is considered most important, followed by solicited sources and scientific journals. While this result is of interest, it should be interpreted with caution. The actual value of each of these sources can likely be better understood with additional study, using more focused questions, interviews, and other research methods designed to identify what kinds of information, within which specific contexts, and to what ends, are obtained from each of these sources. For example, it might be hypothesized that solicited sources, requiring greater expense and effort to access than the web, may be more important in certain situations.

Table 25: Importance of Sources of Scientific Information

Source	Weighted value
World Wide Web	145
Solicited source (<i>e.g. consultant, expert testimony</i>)	132
Scientific Journal	129
Popular Media (<i>e.g. newspapers, magazines, radio, television</i>)	120
E-mail Listserv	111
Unsolicited source (<i>e.g. lobbyist, briefings, constituent-provided</i>)	104

The survey included an opportunity to identify other sources of scientific information. Thirty-four respondents listed one or more such sources. These results are provided in Table 26.

Table 26: Other Sources of Scientific Information

Source	Times mentioned
Other agencies	8
Staff	5
Research	5
Meetings/conferences	5
Academic	3
Reports	2
Peer review/professional advice	2
Environmental organizations	2
International Joint Commission	1
Congressional Research Service	1
Traditional ecological knowledge	1
Members	1
Public	1

6. RECOMMENDATIONS

Respondents were asked to provide up to three recommendations for making Great Lakes science more accessible to their organization's policy activities. For analysis, these recommendations were then placed within 11 categories, as listed in Table 27. As this table indicates, recommendations were dominated by two categories: the need to improve mechanisms for dissemination of science; and the need to improve the dialogue between science and policymakers, to enhance the relevance of science.

Illustrative examples of the first category of recommendation are:

- Some sort of monthly newsletter highlighting science. Target senior policy folks for receipt.
- Shared and easily available peer reviewed science be openly available to all Governmental agencies at any level.
- Make all scientific journals available on-line.
- Helping to ensure that information is available to those who are located in rural/ remote areas, whether electronically or otherwise.

Illustrative examples of the second category of recommendation are:

- Make research community more aware of policy research needs.
- Tailor the science and accessibility of it to the needs of the states and state agencies.
- The science needs to be more directly linked to specific policy questions, such as those stated above, and anchored in the "physical, chemical and biological integrity" restoration goals of the GLWQA.

Table 27: Recommendations by Weighted Frequency of Mention

Recommendations	Frequency
Improved dissemination of science	56
More relevant science, through dialogue	39
Change institutions of science	4
Develop mechanisms to evaluate quality, relevance of science	4
Increase awareness of current research	3
Increase involvement in policy	2
Increase support for science	1
Increase public involvement in science	1
Harmonize scientific methods across jurisdictions	1
Harmonize standards, regulations across jurisdictions	1
Define clear goals, objectives for Great Lakes	1

The dominance of recommendations for dissemination of science among all recommendations suggest a strongly-felt need to ensure effective communication of results generated by the scientific community. The second category of recommendations is also noteworthy, as they suggest a strong desire to ensure that research is relevant to policy priorities.

If we examine the recommendations for improved dissemination of science more closely, several more specific categories of recommendations emerge. These include the following recommendations:

Improved translation or summaries of research results. These recommendations imply further processing of research results, to make them more useful or accessible to non-scientists. For example:

- More fact sheets that summarize significant findings
- GIS mapping is the way everyone is going. It's cheap (to use), user-friendly and adjusts to the sophistication of the user. It was recommended that information about water quality, quantity, biodiversity, land-use, location of point sources and so on, all be made available on a great big Great Lakes GIS site
- Need to develop means of disseminating "plain English" translation of scientific research to policy makers (legislators, governors, department heads, etc.)

Improved access to research results, particularly through centralized databases (not implying translation or other processing results). For example:

- Make all scientific journals available on-line
- Ease of access to bibliographic data base files
- The creation of a centralized library devoted to Great Lakes information and collecting scientific, legal, political, social, economic and historical data...
- Coordinated scientific data collection, storage, and accessibility provisions must be a priority within government agencies

Improved communication – other aspects. Several recommendations addressed diverse aspects of communication. For example:

- Shared and easily available peer reviewed science be openly available to all Governmental agencies at any level
- Better education of local radio, newspaper and television personnel
- Public interest groups with small budgets should be able to access important information for free

Meetings and other events for direct communication of research results, for the general public, and/or for policy makers. For example:

- More forums where science is presented to communities
- Holding technical forums
- Regular seminars by leaders of science in the research community. Audience should be policy folks

Improved use of the internet for communication (note: use of the internet was also often mentioned in other recommendations addressing other aspects of communication). For example:

- Helping to ensure that information is available to those who are located in rural/remote areas, whether electronically or otherwise.
- More effective web sites
- Web based newsletter including telephone and web addresses for contacts at IAGLR.

Improved awareness of and access to experts. For example:

- Have web-site directory where you could find info or identify expert on particular issues

Improved dissemination of research conducted in remote areas. There was concern expressed that knowledge produced in remote areas be widely available. For example:

- Helping to ensure that the research/data generated by those working in rural/remote areas is widely available.

The frequency with which these categories of recommendations were provided is indicated in Table 28. As the table indicates, there is a strong demand for providing research results in more accessible formats, particularly through “translation” of results into non-technical language, or through summaries of significant results.

Table 28: Recommendations for Improved Dissemination of Research

Recommendation category	Number of recommendations
Translation/summaries of results	16
Improved access to results	11
Communication – other aspects	11
Meetings	8
Use of internet	6 (note also mention of internet in many other recommendations)
Access to experts	2
Dissemination of results from remote areas	2

The 38 recommendations for more relevant science also repay closer examination. Here, as well, several more specific categories of recommendations emerge. These include the following:

More opportunities for discussion, interaction between scientists and policy people. For example:

- Personal and regular meetings with the science community to identify issues
- Interact more with resource managers using science to support resource management decisions, thereby increasing scientists' visibility and accessibility and "advertising" the successful application of scientific principles and data to resource protection
- A policy-science Forum at IAGLR every other year
- Find/create mechanisms that build accessible relationships between legislators and scientists/research institutions that support an open door rapport for Q & A

Ensure awareness among scientists of policy research priorities, and that they respond to these priorities. For example:

- Strengthen communication links between research scientists and policy personnel in our organization to ensure science meets policy needs and policy makers are aware of science research requests presented to researchers by stakeholders
- A need exists to make the research community more responsive to policy needs. Presently, given the dearth of federal funding for Great Lakes research, most federal scientists act more like university researchers- raising their own funds from outside sources and chasing dollars rather than responding to stated policy priorities. Federal research agencies need to enhance responsiveness. This does NOT require more institutions and bureaucracy, or new program initiatives; just a commitment to work in a collegial manner
- Develop a spreadsheet of research needs (established by the policy/implementing organizations) and what/who research is being performed to meet the needs. Then a gap analysis to show what needs are not being met by current research

Identification of policy implications of research results. For example:

- Package the end product in policy terms--what policy question or outcome does the research have a good chance of informing?
- The science needs to be more directly linked to specific policy questions, such as those stated above, and anchored in the "physical, chemical and biological integrity" restoration goals of the GLWQA.
- Package the research results in a collaborative way and an accessible way so policy makers can make sense of it in their world. Don't expect them to look at outcomes of a narrowly scoped study on water fleas and then extrapolate to what that would mean for their advocacy with an agency or reflection in policy.
- Most scientific journals have little or no applicability to policy development and application. Hence, they tend to be read only by other researchers. Some effort to answer the "so what" questions, like the former publication Limnos did, would be worthwhile.

Stronger role for scientists in policy activities. For example:

- Better participation of research scientists in regional inter-governmental organizations such as Great Lakes Fishery Commission, Lamp process etc.

The frequency with which each category of recommendations was provided is indicated in Table 29. As the table indicates, there is a strong demand for improved interaction between scientists and those who may need to apply research results in a policy context. Many respondents noted simply the need for more opportunities for such interaction; others (as summarized above) went beyond this, to recommend either more attention to identifying the policy implications of research, or that scientists respond more effectively to policy research priorities.

Table 29: Recommendations for Improved Relevance of Research

Recommendation category	Number of recommendations
Interaction between scientists, policy people	14
Identify policy implications of research	13
Response by scientists to policy priorities	9
Role for scientists in policy	2

Finally, a concern expressed by one respondent regarding efforts to enhance the science/policy connection should also be noted:

“I do have a concern about creating more committees/ bureaucracy in the name of science/ policy linkages unless no other options exist. For example, in the area of aquatic nuisance species prevention and control, one of the major problems right now is the proliferation of boards, panels and committees that are all addressing the science and policy aspects of the issue. Many in the Great Lakes community are now calling for a reduction in such efforts, due to concerns about unwarranted duplication of effort. Thus, I believe that we should work through existing vehicles to strengthen the linkage where needed. My recommendations (identified above) speak to some of the things that might help the cause. For example, in my experience, scientific journals are seldom consulted by policymakers/ managers and, thus, have very little value in addressing science/ policy linkages. This could be improved if the literature was abstracted and "translated" for the user community, and focused specifically on the "so what" question (i.e., why is this research important and how can I use it?) It might be a good idea to focus on some of the issues being identified by the Emerging Issues Work Group of the Science Advisory Board of the IJC. Emerging issues are less likely to have science/ policy linkages associated with them.”

7. POLICY ADVISORY BOARD INPUT AND RECOMMENDATIONS

On June 13, 2001 at least 35 individuals representing a broad cross-section of Great Lakes Science and Policy organizations met to discuss the survey results pertaining to the International Association for Great Lakes Research project to strengthen the science-policy linkage in the Great Lakes Basin. A list of these participants is provided as Appendix 7 to this report. Participants were provided with copies of the draft report titled “Great Lakes Science and Policy: Strengthening the Connection: Report of a Survey of Great Lakes Policy Issues.” That report presented the results of the survey of Great Lakes policy institutions conducted during early 2001 with the support of The Joyce Foundation.

Meeting Agenda

- I. John Hartig, President, IAGLR: Welcome and introduction to IAGLR study of Great Lakes science and policy.
- II. Stephen Bocking, Trent University: Overview of survey of Great Lakes policy issues, and summary of results.
- III. Small-group discussions to identify key Great Lakes policy issues.
- IV. Plenary discussion to identify next steps in study.

Identification of Key Issues

Participants identified the following key issues that may be used to guide further study in the Joyce-IAGLR Great Lakes Science-Policy Initiative. Comments relating to each issue, as provided by discussion participants, are also provided.

- *Impacts of large livestock feeding operations.* This is an emerging issue, of concern across much of the Great Lakes region, that involves policies and actors at several scales, as well as a range of environmental impacts, on water quality, fisheries, and habitat. The issue may be of special relevance and interest at next year’s IAGLR annual meeting, to take place in Winnipeg, Manitoba.
- *Diversion and/or export of water from the Great Lakes Basin.* This issue is now receiving considerable attention, and would benefit from examination of what science is needed to make effective decisions. The issue has several dimensions, including lake levels, the impact of climate change, and the economic implications of diversion.
- *Beach closings.* This issue raises questions concerning regulation, such as whether regulations really protect health, and whether they are based effectively on science. Policy makers identified a need to predict beach closings. Further, there is a need for science to play a critical role in setting uniform and consistent standards. This issue would be highly relevant throughout the basin.

- *Successful and unsuccessful issues.* It was suggested that, beyond focusing on any specific issue, it would be helpful to examine “success stories,” i.e. issues in which science has played an effective role. Examples mentioned included the binational phosphorus control program, Green Bay, and the Lower Lakes Reference. It was also suggested that a “success story” be compared with a less successful issue, with the success serving as a “control” in a control/experimental study format. Finally, acid rain was suggested as an example of how science has not been translated well into policy.
- *Other issues.* Several issues were mentioned, without supporting comments: non-point sources, sediments, exotic species, airborne toxics and their regulation, and developing population-specific methods of information/education exchange through which more culturally sensitive indicators of Great Lakes ecosystem integrity may emerge.

Additional Recommendations from the Policy Advisory Board Meeting

In addition to identifying key issues for further study, participants of the Policy Advisory Board meeting also provided additional recommendations to help guide the project through its remaining phases. These recommendations include:

- Participants agreed that IAGLR should pilot test strengthening the science-policy linkage on specific issues;
- The issues must be relevant to policy makers and timely;
- Each issue to be pilot tested must have a sufficient body of scientific knowledge (e.g., water diversion, global climate change);
- The States and Provinces could benefit from IAGLR addressing both economic and ecological impacts of a particular problem (scientifically defensible information on economic value and benefits is frequently needed in policy development);
- IAGLR needs to consider a larger role for social science, including economics, in developing scientific perspectives on the Great Lakes;
- Because the public drives policy, IAGLR should consider interacting with nongovernmental organization partners on this project;
- IAGLR should consider using the web site to interact with the public and to poll members;
- IAGLR may want to partner with other professional societies like the American Chemical Society, Water Environment Federation, etc.;
- IAGLR could play a major role in educating and informing policy makers and the media -- science translation and timely communication are very important to policy makers;

- IAGLR should experiment with using conferences to link with the media and key stakeholders (IAGLR may want to have a media room at future conferences and hold a press conference);
- IAGLR could seek more contact with students and with others within the communities in which IAGLR meetings are held;
- Targeting and translation of science can be very effective (American Association for the Advancement of Science has prepared perspectives written by scientists for policy makers; Limnos was a publication written to translate and communicate science to a lay audience, including policy makers);
- IAGLR should experiment with the use of round tables, panel discussions, and public hearings to translate and communicate science to policy makers (each has particular strengths and limitations that must be considered).

Potential Partners in Great Lakes Science-Policy Initiatives

Several organizations were identified as potential partners in studies of Great Lakes science and policy. Although not intended as the final list, these potential partners include:

- Lake Michigan Federation (now involved in study of beach closings);
- Society of Environmental Journalists;
- New York Legislators (as an example of an effort at self-education);
- North East Midwest Institute;
- Great Lakes Commission.

The need to work with the public, and with non-governmental organizations, was strongly encouraged by participants of the policy advisory board meeting.

8. NEXT STEPS

Where We've Been

The Great Lakes Science-Policy Initiative was conceived to promote better Great Lakes policy development by strengthening the connection between the science and policy communities. With the support of the Joyce Foundation, IAGLR has completed two key activities in the project: firstly, it has conducted the *Survey of Great Lake Policy Issues* (see Appendix 3) to identify high-priority Great Lakes policy issues that would benefit from a stronger linkage between scientists and policy-makers; secondly, it has created the Great Lakes Science-Policy Advisory Board, with which it has consulted in the identification of key issues and recommendations to help guide the project through its remaining phases. These activities have laid the foundation for addressing three of these key issues via web-based access to the Association's expert membership and the *Journal of Great Lakes Research* archive.

Where We're Going

Results from the first year will guide activities in the second year. These activities will focus on translating scientific information about priority issues for the policy-making community and providing this information via the Internet in a useful format to support decision-making. Information will include ready access to the Association's expert resources and relevant Journal articles. In addition, IAGLR will partner with policy institutions to pilot test methods that facilitate ongoing dialogue between scientists and policy-makers.

To meet these goals IAGLR will complete the following project activities over the next year-and-a-half. These tasks will help bridge the gap between science and policy in the Great Lakes community, and provide a strong foundation upon which to build this network in future years.

1. Build an Expert Resource Directory

IAGLR is presently developing a database of its member scientists and researchers who have agreed to serve as expert contacts to policy-makers on various issues. This database will be available from the IAGLR web site and searchable by area of expertise, as well as other desired criteria identified by policy-makers.

Association members will be solicited to serve as experts on specific Great Lakes topics. This Great Lakes expert directory will help provide a simple mechanism for "one-stop shopping" to access Great Lakes expertise by Great Lakes policy developers.

2. Build a Repository of Great Lakes Research Based on IAGLR's *Journal of Great Lakes Research*

To provide a solid scientific foundation to inform public policy regarding the Great Lakes, IAGLR is presently converting its hard-copy archive of the *Journal of Great Lakes Research* to electronic format (PDF) to make it readily accessible via a searchable database on the Association's web site. The database will include metadata (such as title, author, keywords, etc.) about each journal article, which can be queried from pages that provide an overview of relevant issues identified by policy-makers during the survey phase of the project.

IAGLR will build on this Joyce Foundation-supported effort by continuing to add current issues of the journal to the database after this project has been completed. This activity will be supported via the dues increase recently assessed by the Association to support online activities. The research papers will be available at no cost to policy-makers and other interested stakeholders.

3. Identify Great Lakes Policy Development Partners for Pilot Project

To begin the second year of project activities, IAGLR will obtain commitments from Great Lakes policy development organizations and institutions to participate in a pilot project aimed at strengthening the science-policy linkage. IAGLR will identify lead Great Lakes policy development institutions to partner with the Association to address each of the three high-priority policy issues identified by the Policy Advisory Board. A different partner organization will be involved with each issue, and will work with IAGLR on the remaining tasks.

4. Translate Relevant Science for Policy-makers

Under the direction of the Association and its partners, an overview of each of the high-priority issues will be prepared and posted on IAGLR's web site in a useful, readily accessible format. Each issue paper will provide an overview, a section of relevant journal articles (resulting from a query to the database), and expert contacts from IAGLR's membership available to answer further questions.

5. Facilitate Dialogue between Policy-makers and Scientists Regarding Information Needs

IAGLR and its partner organizations will facilitate electronic dialogue between policy-makers and scientists to address specific questions and further policy development on each of the three policy issues. IAGLR will establish a policy-science discussion board and host a series of Internet conferences on the Association's web site. The use of these Internet technologies will be tested as methods to strengthen the connection between policy-makers and scientists. Additional methods may be identified during the project (e.g., through the recommendations of the Science-Policy Advisory Board), and these also will be tested during this pilot phase. Moreover, this effort may help to identify questions that remain unanswered because of a lack of data or technical understanding, and in so doing will help establish value-added research needs, thereby providing a strong incentive for IAGLR members to participate in this process.

6. Evaluate and Fine-tune Approaches to Strengthen the Science-Policy Linkage

IAGLR will develop a strategy for evaluating the project's effectiveness in strengthening science-policy linkages and advice for the Association and larger Great Lakes community on improvements and continued use of these tools in the future. At a minimum, IAGLR will survey policy-makers to determine if they used the service, if the information aided in decision-making or better serving their constituency, and how the service could be improved for future use.

7. Final Report

At the end of this science-policy exercise, IAGLR and its partner organizations will prepare a summary report of project activities and findings.

8. Disseminate Project Information

As an ongoing task, IAGLR has engaged in significant outreach to advertise this initiative and to make both scientists/researchers and policy decision-makers aware of the benefits to be derived from this enhanced communication. Continued efforts will focus on disseminating project results and encouraging interaction between policy-makers and scientists on the three policy issues identified by the Great Lakes Science-Policy Advisory Board.

These efforts will include announcements via regional listservs (such as the IAGLR membership listserv and glin-announce), as well as coverage in regional newsletters and web sites. In addition, IAGLR's annual Conference on Great Lakes Research provides the perfect vehicle for sharing vital information and securing ongoing participation in this initiative.

This project lays the foundation for continued outreach to policy-makers and will inform future activities of the Association. In addition, it will build the infrastructure that will enable this ongoing outreach to occur.

9. REFERENCES

Great Lakes Commission, 2001. *The Great Lakes Program to Ensure Environmental and Economic Prosperity*, Working Draft, March 2001. www.glc.org

International Association for Great Lakes Research, 2000. *Great Lakes Science & Policy: Strengthening the Connection*, Proposal submitted to the Joyce Foundation, August 15, 2000.

National Council for Science and the Environment, 2000. *Recommendations for Improving the Scientific Basis for Environmental Decisionmaking: A report from the First National Conference on Science, Policy, and the Environment*, December 2000.

Appendix 1: GREAT LAKES SCIENCE & POLICY PROJECT STEERING COMMITTEE

In January 2001, IAGLR created a steering committee to help guide the project. Members of the steering committee are as follows:

Stephen Bocking

Associate Professor, Environmental and Resource Studies Program Trent University, Peterborough, Ont.

Joseph DePinto

IAGLR Publications Committee Chair; Limno-Tech, Inc., Ann Arbor, Mich.

Wendy Foster

IAGLR Business Manager, Ann Arbor, Mich.

John Gannon

Science Coordinator, USGS Great Lakes Science Center, Ann Arbor, Mich.

John Hartig

IAGLR President; Greater Detroit River American Heritage River Initiative, Detroit, Mich.

Michael Jones

IAGLR Past President; Department of Fisheries and Wildlife, Michigan State University, East Lansing, Mich.

Gail Krantzberg

IAGLR Outreach Committee Chair; Great Lakes Strategic Coordinator, Ministry of Environment, Toronto, Ont.

Gerald Matisoff

Editor, *Journal of Great Lakes Research*, Department of Geologic Sciences, Case Western Reserve University, Cleveland, Ohio.

Paula McIntyre

IAGLR Webmaster; President, Loracs Creations, Inc., Ann Arbor, Mich.

R. Stephen Schneider

Managing Editor, *Journal of Great Lakes Research*; University of Michigan, Center for Great Lakes and Aquatic Sciences Ann Arbor, Mich.

John V. Stone

Project Survey Manager; Visiting Scientist, NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, Mich.

Rochelle Sturtevant

Sea Grant Extension Agent, NOAA Great Lakes Environmental Research Laboratory, Ann Arbor, Mich.

Appendix 2: INVITED STAKEHOLDERS AND RESPONDENTS

Survey respondents

Governance Agencies

Great Lakes Commission
 International Association of Great Lakes and St. Lawrence Mayors
 Great Lakes Fishery Commission
 International Joint Commission

US Federal Government

Bureau of Indian Affairs, Department of Interior
 Natural Resources Conservation Service
 US Army Corps of Engineers, Chicago District
 US Senator DeWine, Washington
 US Army Corps of Engineers
 Great Lakes Environmental Research Laboratory
 US Fish and Wildlife Service
 Bureau of Indian Affairs, Great Lakes Agency
 Bureau of Indian Affairs
 NOAA - Coastal Programs Division
 National Park Service (Midwest Region)

US State Government

Pennsylvania Department of Environmental Protection -- Office of the Great Lakes
 New York Coalition of Great Lakes Legislators
 New York Department of Environmental Conservation
 Illinois DNR - Law Enforcement
 Ohio Lake Erie Commission
 Council of Great Lakes Governors
 Ohio DNR, Division of Watercraft
 Legislative Commission on Minnesota Resources
 Michigan Office of the Great Lakes

Canadian Federal Government

Environment Canada
 Geological Survey of Canada, Bedford Institute of Oceanography
 Department of Indian Affairs and Northern Development
 Canadian Coast Guard
 Environment Canada, St. Lawrence Centre
 Canadian Consulate General (Detroit)
 Transport Canada Marine Safety

Canadian Provincial Government (Ontario)

Ontario Ministry of Natural Resources
 Lakehead Region Conservation Authority
 Ontario Clean Water Agency
 Conservation Ontario

Academic Organizations

Center for Great Lakes Culture
 Great Lakes Research Consortium
 Center for Great Lakes Environmental Education
 Pennsylvania Sea Grant
 Legal Institute of the Great Lakes
 University of Minnesota Sea Grant
 Illinois-Indiana Sea Grant
 New York Sea Grant

Industry

American Forest and Paper Association
 Council of Great Lakes Industries
 Falconbridge Limited
 Great Lakes Power Limited
 Saint Lawrence Seaway Development Corporation
 Council of Great Lakes Industries

Environmental Organizations

Sierra Club Eastern Canada Chapter
 National Wildlife Federation
 Canadian Environmental Law Association
 Great Lakes Sport Fishing Council
 Canadian Institute for Environmental Law and Policy
 Great Lakes Protection Fund
 The Nature Conservancy
 Great Lakes United
 Sierra Club Great Lakes Program

Native Organizations

Great Lakes Indian Fish and Wildlife Commission
 Chippewa-Ottawa Resource Authority
 Native American Institute, MSU
 Grand Traverse Band of Ottawa and Chippewa Indians

Other Organizations

Northeast-Midwest Institute
 Holistic Impax Group
 Ontario Water Works Assoc.

Survey non-respondents

1854 Authority

Bureau of Indian Affairs, Eastern Regional Office

Canadian Centre for Inland Waters

Canadian Chemical Producers Association

Canadian Council of Ministers of the Environment

Canadian Environmental Assessment Agency

Canadian Marine Manufacturers Association

Canadian Society of Environmental Biologists

Canadian Trade Office, Council of Great Lakes Governors

Canadian Water Resources Association

Canadian Wildlife Service-Ontario

Citizens Environment Watch

Consulate General of Canada, Buffalo

Consulate General of Canada, Chicago

Consulate General of Canada, Minneapolis

Detroit District, U.S. Army Corps of Engineers

Ducks Unlimited Canada

Environmental Commissioner of Ontario

Federation of Ontario Cottagers' Associations

Federation of Ontario Naturalists

First Nations Chiefs of Ontario

Friends of the Earth

Great Lakes 2000 Cleanup Fund

Great Lakes Agriculture and Resource Management Committee

Great Lakes and Ohio River Division, U.S. Army Corps of Engineers

Great Lakes and Ontario Region, First Nations Environmental Network

Great Lakes and Tourism Committee Chair

Great Lakes Boating

Great Lakes Center, U.S. Army Corps of Engineers, Great Lakes Ohio River Division

Great Lakes Charter Association

Great Lakes Commerce Committee

Great Lakes Congressional Task Force, House Co-Chair (5 non-respondents)

Great Lakes Conservation and Outdoor Recreation Committee

Great Lakes Intertribal Council

Great Lakes Land Use and Environment Committee

Great Lakes National Program Office, EPA

Great Lakes Radio Consortium

Great Lakes Region, Coastal Zone Management Program (MI, MN, OH, IN, PA, WI, IL)

Greenpeace Canada

Haudenosaunee Environmental Task Force

Indiana Boating Law Administrator

Laidlaw Foundation

Michigan Boating Law Administrator

Michigan Sea Grant College Program

Minnesota Boating Law Administrator

National Research Council
New York Boating Law Administrator
Ninth District, U.S. Coast Guard
Northeast Midwest Institute
Northeast Region, U.S. Fish & Wildlife Service
Northern Association of Boating Administrators
Office of Boating Safety, Laurentian Region, Canada Coast Guard
Office of the Auditor General
Ohio Sea Grant College Program
Ontario Environmental Network
Ontario Federation of Agriculture
Ontario Federation of Anglers and Hunters
Ontario Marina Operators Association
Ontario Mining Association
Ontario Minister of the Environment
Ontario Ministry of Municipal Affairs and Housing
Ontario Ministry of Natural Resources
Ontario Ministry of Natural Resources-GL Heritage
Ontario Ministry of Natural Resources-Waters Program
Ontario Ministry of the Environment
Ontario Parks
Ontario Public Advisory Council
Ontario Region, Indian and Northern Affairs Canada
Ontario Region, Transport Canada
Ontario Regional Chief, Assembly of First Nations
Pennsylvania Boating Law Administrator
Policy Center, National Association of Conservation Districts
Pollution Probe
Quebec Marine Trades Association
Québec Ministry of the Environment
Quebec Region, Environment Canada
Quebec Region, Indian and Northern Affairs Canada
Quebec Region, Transport Canada
Quebec Regional Chief, Assembly of First Nations
Quebec Wildlife Federation
Secretariat, International Great Lakes-St. Lawrence Mayors Association
Sépaq/Parcs Quebec
Sierra Legal Defense Fund
St. Lawrence River Institute for Environmental Sciences
St. Paul District, U.S. Army Corps of Engineers
U.S. Geological Survey, Great Lakes Coordinator
Union of Ontario Indians
University of Wisconsin Sea Grant Institute
Waterfront Regeneration Trust
Wildlife Habitat Canada
Wisconsin Boating Law Administrator

Appendix 3: SURVEY INSTRUMENT

International Association for Great Lakes Research Survey of Great Lakes Policy Issues

This survey seeks to identify Great Lakes policy issues that would most benefit from a stronger connection to science. Therefore, IAGLR seeks your organization's perspective to questions in the following four areas:

1. Great Lakes Policy Issues;
2. Use of Scientific Information;
3. Organizational Information; and
4. Your Comments.

Section 1: Great Lakes Policy Issues

From your organization's perspective, please identify and rank in order of importance the top three Great Lakes policy issues that would most benefit from a stronger connection to science.

For each of these issues, please also provide two key questions that, if answered by the Great Lakes science community, would help your organization further its Great Lakes policy development and management activities.

Most Important Great Lakes Policy Issue: *(Limit 100 characters.)*

Why is this issue so important? *(No character limit.)*

What two key questions does your organization have about this issue? *(No character limit.)*

Question #1:

Question #2:

Second Most Important Great Lakes Policy Issue: *(Limit 100 characters.)*

Why is this issue so important? *(No character limit.)*

What two key questions does your organization have about this issue? *(No character limit.)*

Question #1:

Question #2:

Third Most Important Great Lakes Policy Issue: *(Limit 100 characters.)*

Why is this issue so important? *(No character limit.)*

What two key questions does your organization have about this issue? *(No character limit.)*

Question #1:

Question #2:

Section 2: Use of Scientific Information

To improve our ability to develop more focused information exchanges among Great Lakes science and policy communities, we would like to know how your organization accesses scientific information and seek your input for making that information more accessible to you and other Great Lakes policy organizations in the future.

Does your organization currently use scientific information in formulating/implementing its Great Lakes policies? [If "yes" skip the next question.]

No Yes Don't Know Not Applicable

If "no" above, does your organization plan to use scientific information in formulating/implementing its Great Lakes policies in the future?

No Yes Don't Know Not Applicable

How often does or will your organization use scientific information in formulating and/or implementing its Great Lakes policies?

Never Seldom Frequently Always

We are interested in learning how valuable the following sources of scientific information are to your organization. Please rate each in terms of its value in formulating and/or implementing your Great Lakes policies.

Low Medium High Don't Know Not Applicable

Scientific Journal

World Wide Web

E-mail Listserv

Popular Media *(e.g. newspapers, magazines, radio, television)*

Solicited source *(e.g. consultant, expert testimony)*

Unsolicited source *(e.g. lobbyist, briefings, constituent-provided)*

What recommendations would you give for making Great Lakes science more accessible to your organization's policy activities? *(Please list your top three recommendations in order; No character limit.)*

1st Recommendation:

2nd Recommendation:

3rd Recommendation:

Section 3: Organizational Information

IAGLR is interested in your organization's role in formulating and/or implementing Great Lakes policy. This information will help us to characterize our survey population and conduct role-specific analyses of our survey results.

Please select from the items below the one that best describes your organization's role in Great Lakes policy.

Policy-maker Policy Advisor Policy Advocate Resource Manager Other (describe):

IAGLR is developing a Science-Policy Advisory Board (SPAB). Participation in SPAB activities is voluntary and is being sought from the organizations included in this survey. SPAB members will review survey results, develop consensus on key issues and questions that will be pursued through this project, and provide evaluative feedback as the project proceeds.

How interested would you be in participating as a SPAB member?

Not at all Marginally Quite Very

Please provide the following contact information:

Your Name

Organization

Address

City

State or Province

Zip/Postal Code

Country

Phone

Fax

E-mail Address *(We will send a copy of your responses to this address.)*

Web site Address

Section 4: Comments

Your organization's perspective on Great Lakes science-policy linkages is important to us. Please use the space below to identify and discuss additional pertinent information that may not have been covered in this survey.

Appendix 4: INVITATION LETTER

Subject: Input Sought on Great Lakes Science-Policy Initiative

Dear _____:

On behalf of the International Association for Great Lakes Research, I invite you to participate in our effort to strengthen connections between science and policy in Great Lakes management by completing a brief online survey (<http://www.iaglr.org/scipolicy/survey/about.php>).

Because your organization (_____) is one of a select group that plays an important role in Great Lakes policy, your participation in this research is essential. Invited organizations include tribal, governmental, nongovernmental and private industry groups from both Canada and the United States that have a basinwide focus.

This survey specifically seeks your organization's perspective on Great Lakes policy issues that would most benefit from a strengthened science-policy linkage, and your preferred methods for obtaining Great Lakes science information. Your response will help advance the scientific foundations of Great Lakes policy.

The survey is being conducted throughout March 2001. Please respond as soon as you are able, as your input is vital to the project's success.

An analysis of the survey data will be presented in June at IAGLR's 44th Annual International Conference in Green Bay, Wis., and results will be used to guide project activities. Updates also will be made available on the IAGLR web site (<http://www.iaglr.org>).

This survey is part of a project, "Great Lakes Science & Policy: Strengthening the Connection," supported by the Joyce Foundation. If you have any questions about the survey, please contact either myself at (313) 568-9594, president@iaglr.org, or our survey manager, John Stone, at (734) 665-5303, jvstone@glerl.noaa.gov.

Thank you in advance for your participation in this important research.

Respectfully,

John Hartig
President
International Association for Great Lakes Research

Appendix 5: REMINDER LETTER

Reminder: Input Sought on Great Lakes Science-Policy Initiative

Dear _____:

In a recent message, I invited your organization to participate in the International Association for Great Lakes Research's effort to strengthen connections between science and policy in Great Lakes management. The message included the web address of a brief online survey for you to complete (<http://www.iaglr.org/scipolicy/survey/about.php>).

Your organization (_____) plays an important role in Great Lakes management. You can help us advance the scientific foundations of Great Lakes policy by contributing your organization's perspective on Great Lakes policy issues in our online survey. Please note that the survey period concludes this Friday, March 30, 2001.

If you have any questions about the survey, please contact either myself at (313) 568-9594, president@iaglr.org, or our survey manager, John Stone, at (734) 665-5303, jvstone@glrl.noaa.gov.

Thank you in advance for your participation in this important research.

Respectfully,

John Hartig
President
International Association for Great Lakes Research

Appendix 6: RESPONSES REGARDING PRIORITY ISSUES

This appendix provides the responses for each of the issue areas discussed in Section 3, together with the explanations as to why these issues are important. These responses are provided verbatim, except for spelling corrections and minor editing for clarity.

Water quality: most important issue

- **Under what conditions should natural attenuation be an acceptable option for mgmt. of cont. sediments?** All 42 AOC's in the US and Canada list contaminated sediments as a beneficial use impairment. In many areas, the contamination is wide spread and at low to moderate levels with no known hot spots precluding the option of dredging or capping.
- **Implementing the precautionary principle in general and phasing out PBTs in particular. (issue #1).** The Great Lakes Water Quality Agreement calls for the phase out and elimination of PBTs. Not only has this not been done, but we are likely introducing new PBTs every year. We are rapidly discovering new contaminants that are persistent and bioaccumulative, and that have, in fact, already accumulated in people. We don't know what the impacts of all of these contaminants will be, but we are finding evidence of health and developmental effects for many pollutants, particularly in our children. We haven't studied the cumulative or synergistic impacts of exposure to and accumulation of numerous pollutants, but it would be naive to think that such impacts do not or can not exist. We are failing in our attempt to regulate chemicals by finding them innocent until proven guilty and our children are paying the price in increasing rates of cancer, asthma, developmental problems, and other health effects. We cannot afford to continue down this path and must find a way to fundamentally shift the burden of proving these chemicals safe from regulatory agencies to industry. In the case of PBTs, we must develop an efficient method of screening chemicals for persistent and bioaccumulative properties and must prevent such chemicals from ever entering the market or the environment.
- **We need a simple basin-based compilation of human health indicators.** We don't have it, and yet we are aware of many troubling things: a record number of beach closings in some areas last summer, fish advisories, drinking water alerts or crises in some communities, cancer clusters, asthma/respiratory clusters, other rare disease clusters, numbers of communities who have changed their drinking water supply, etc. When we try to make policy recommendations related to these issues, we have no basin-wide statistics of analyses of any of this.
- **Sediment a Developing the contnd nutrient management (sic).** Sediment and nutrients impact all biological habitat and also have tremendous impacts on the quality of water that basin residents use for a variety of purposes.
- **Preservation and improvement of water quality.** The majority of Ontario's population takes its drinking water from the Great Lakes. The preservation of high quality sources is fundamental to social and economic stability.

- **Addressing the continuing threats from toxic chemicals in the Great Lakes region.** The Great Lakes environment has been subject to releases of thousands of toxic chemicals for decades. These chemicals can impact the health of aquatic life, wildlife, and humans in the region. While there has been progress in reducing the releases of some toxic chemicals, there is a continuing need to address ongoing releases (whether from current industrial sources, contaminated sediments, disposal sites, or other sources). In addition, there are a number of chemicals of potential ecological and human health significance being released (e.g. PBDEs, persistent fluorinated compounds), about which very little is known.
- **Pollution from land use.** Sprawl and development in general are growing in the Great Lakes. Current trends in land use practices point to severe increases in pollution and may offset gains in remediation of existing contaminated areas.
- **Water quality and consequences for humans and the fishery/resource base.** The water is one of our primary resources in the region and quality of life depends on clean water. Much of the regions economy is also tied to recreational use of Great Lakes and water quality is always a key issue related to travel and tourism.
- **Understanding the linkage between land use and water quality.** Land use practices are increasingly being identified as determinants of environmental quality and, specifically, water quality in the tributaries, near shore areas and open waters of the Great Lakes. Urban and suburban sprawl, ill-advised development practices, the increase in impervious surfaces, traffic congestion and associated air quality issues, and improper agricultural practices are all "land-side" determinants of Great Lakes water quality. And, nonpoint source pollution is now the leading pathway for pollutant loads to the lakes.
- **Source Protection.** >Public health >Protection of the ecosystem for future generations.
>Shoreline development
- **The presence of persistent toxic substances.** Even though substantial reduction have been observed over time, to reach much lower levels as compare to the 1970's, the levels are stable now (plateau).
- **Water quality relative to recreational boating and commercial shipping.** The Governor of Ohio has established a goal of having Lake Erie declared a "no discharge" zone, concerning human wastes being emitted from vessels, by the year 2003. Water quality is a vital issue for health, safety, enjoyment, habitat and commerce reasons. In response, the boating community needs to identify related problems and address them.
- **Allowing continued atmospheric deposition of mercury & other contaminants.** Tribal people subsist on fish, wildlife, wild rice and other items collected from the Great Lakes region. The levels of mercury in fish appears to be on the rise. Phyto uptake of mercury and other contaminants is largely unknown.
- **Ecological, economic, and social impacts of changes to water quantity and water quality.** The basis for present day decisions to ensure sustainable development.
- **Water quality/quantity.** Controversy about target nutrient and water levels and responses of aquatic and human populations.

- **Maintenance and supply of fresh/drinking water.** The vast majority of population growth in the next 35 years in Canada is projected to occur around the Great Lakes. Adjacent and surrounding communities rely on the Great Lakes for provision of safe drinking water and for treated sewage repositories. Due to inconsistent quality and quantity issues associated with ground water supplies, the Great Lakes are continually viewed as the "better alternative" for the provision of water. Licensing and permitting of water taking occur at the provincial level in response to local demands. Coordinated cross-municipality (or ecosystem) planning is virtually non-existent. In Ontario, proposals have been submitted to pipe Lake Ontario water, across communities that receive no benefit, to communities further afield that want to increase growth. Provision of consistent and safe water supplies are viewed as economic drivers and as the "engine for growth". The concern is that reliable data on taking large quantities of water from the Great Lakes has not been done in a way that is methodologically consistent across political jurisdictions. There is a need for consistent benchmarks and more research on the linkages of human behaviour (social science) and the physical/natural sciences. While permitting and licensing occur in response to local demands, planning would benefit through the adoption of a larger perspective.

Water quality: second most important issue

- **Toxics.** The millennium pipeline issue and policies relevant to allowing this devastating practice to exist. Lake Erie is known for its ice scouring events, disrupting sediments, potential toxics, fish kills, oil leaking into water, the long distance of shut off valves to the pipe, many other items.
- **Improve and maintain water quality.** Water quality affects many aspects of shoreline community life from providing suitable water for drinking and use in industrial processes to marine recreation.
- **Contaminated sediments.** Contaminated sediments are continually re-released to the ecosystem and areas with contaminated sediments are restricted from all possible uses.
- **Persistent toxins & provision of coordinated standards for drinking water & sewage.** Coordinated or comparable standards for drinking water quality and sewage discharge would ensure consistency across political jurisdiction. Privatized water and sewage treatment facilities would have consistent operating standards. Members of the public would have the basis for "report cards". Levels of discharge of persistent toxins could be monitored.
- **Safe drinking water for First Nations who rely on the Great Lakes for potable water.** Our agency is concerned with the health and safety of First Nation communities.
- **Pollutants/contaminants throughout the ecosystem.** Native peoples (and many non-natives) of this region consume fish, wild rice, game animals, drinking water, and plants where the contaminates bioaccumulate through the food chain.
- **Cargo residue's.** Effects of cargo residue on the Great Lakes ecosystem and water quality.
- **Water quality - Meeting the GLI standards.** The Great Lakes Initiative established priority contaminant standards which the States have agreed to pursue through the SPDES and other related State water quality management programs. However, the GLI contaminant concentrations are often levels of magnitude less than previous water quality standards thereby challenging the limits of current sampling methods, analytical detection capabilities, data interpretation, and technological response.

- **Links between use and air and water quality in the Great Lakes Basin (at a watershed scale).** Urban growth pressures, shoreline development pressure, recreation/fishing demands must be managed in the context of sustainable use and the impacts must be mitigated. It is also important since it impacts on human health.
- **The health impacts of toxic chemicals in the GLs.** With deregulation, voluntary compliance and government cuts and marketplace issues dominating public policies, we have lost our infrastructure for strong laws to protect the health of the Great Lakes ecosystem and all live dependent on it and our ability to prevent further contamination.
- **How to better assess the relative importance to GL water quality of various stressors.** Similar reasoning as above. Stubborn insistence on "zero discharge" may misallocate resources away from stressors that have a much greater impact on water quality.
- **Managing the atmospheric deposition of toxic air pollutants (please list this issue as #2).** This is perhaps the most important source of continuing (and increasing) toxic inputs to the Great Lakes. The Great Lakes ecosystem will not recover and fish will not be safe to eat if we do not control the emission and deposition of pollutants like mercury and dioxin. However, the successful regulation of air pollution sources will require a solid scientific understanding of source/sink relationships, the level of air pollution that will result in water quality impairments, the sources of air pollutants that are of concern to the Great Lakes, and many other questions. This issue needs to be addressed quickly, and could thus benefit from strategic, targeted scientific studies designed to provide the information needed to move forward with regulatory action.
- **Introduction of new chemicals including pharmaceuticals into the environment.** Current monitoring is indicating that many new chemicals are appearing in the environment, particularly pharmaceuticals. Many of these chemicals are design to affect biological systems including humans. These chemicals are currently not removed through existing wastewater treatment system and appear to have cause biological affects in the environment.
- **Water quality, e.g., water diversion.** What are environmental/ecological impacts of water diversion consequences? Economic impacts? Policy pathways? / _ * Toxic contaminant issues. Criteria? Implementation of LaMPs, RAPs, Cost/benefit valuations of prioritizing remediation. Fish advisories/tourism issues. The challenge for the legislators and the biophysical scientists is to bridge the gap between legislators who often require "leaps of faith" in policy making based on incomplete data and biophysical scientists who are bound to rigorous, incremental protocols. Legislators and staff do not read academic research journals, typically. Who stands in the gap to translate science into policy suggestions? Usually advocacy groups--that's their niche. Therefore, if a few priority issues could be identified that, if resolved, would influence the other issues, then legislators could see the target and know when they got there.

Water quality: third most important issue

- **Water quality and usage.** Human health and economic impacts resulting from degraded water (chemical and biological pollutants) are great. Growth and sustainability will not be possible in coastal regions with poor water quality.

- **Control and reduction of chemical contaminants.** Chemical degradation of aquatic habitats in the form of persistent toxic substances remains a problem in the Great Lakes. Acute (lethal) effects of toxics on fish appear to be less of a problem than chronic (sub-lethal) effects. Potentially serious sub-lethal effects include interactions among toxics such as synergistic effects and other maladies such as estrogenic effects and fish diseases. The chronic effects of toxics on wildlife have become better understood during the last decade and certain fish-eating birds, reptiles, and mammals are especially sensitive. Fortunately, the impacts on wildlife have decreased as overall levels of toxic substances declined in response to controls imposed in the 1970s. The effects on humans from consuming contaminated fish continue to be researched extensively. Some Great Lakes fishes are contaminated sufficiently that human consumption is not advised, especially for certain risk groups such as women of child-bearing age. Recreational and commercial fisheries can be devastated by consumption advisories or prohibitions on marketing that apply to one fish species and area but that then taint the public's image of all Great Lakes fishes.
- **Aquatic Contaminants.** Sediments of the Great Lakes still have an inventory of many contaminants from the past several decades and some of these materials are available to the biota. In addition, many contaminants continue to leak into the lakes from uncontrolled diffuse sources. New research is showing that low levels of many contaminants (i.e., Mercury) may pose more of a risk than earlier believed.
- **Science to support banning known harmful substances.** The one conclusion no one can argue with is that the only way to effectively eliminate harmful substances in the Great Lakes is to ban them.
- **Airborne contaminants into the lake water.** Mercury has become a problem in lake aquatic life.
- **Air transport and deposition of persistent, bioaccumulative toxics.** Except for historic sediment contamination and fugitive emissions, air sources are the primary source of ongoing loadings of mercury and dioxin, for instance, into the Great Lakes and other waters in the region. Some sources may be close, some far away. Air policy and law is not blended well with water policy and law in this area.
- **Out-of-basin, airborne contaminants.** Regardless of supply/demand, if contaminated there would be serious ramifications.
- **Non-point source polluted runoff.** This source of pollution to our waterways has eclipsed the point sources and is the hardest to address because of the vast culture change it requires to get people to recognize the damaging effects of their behavior and change that behavior.
- **The adequacy and sufficiency of reception facilities.** Facilities provide disposal of potentially harmful substances.
- **The links between watershed, human and Great Lakes health.** Monitoring programs have been affected due to fiscal constraints. Understanding the link to human health factors will help reinforce need for ongoing monitoring.
- **Relationship between aquatic populations/health and toxics and exotic species stresses.** There seems to be a growing relationship between stress on existing and introduced aquatic species with toxics and new introduced exotics. In order to management for introduced exotic species and reduction of trace toxic substances we need to understand these relationships better.

Water quantity: most important issue

- **Inter-basin diversion.** The consequences of new diversions may ultimately dwarf natural fluctuations and thereby compound problems that exist during low water periods.
- **Water supply and use in the Great Lakes Basin at a watershed level.** With the impact of climate change we, at the watershed level, need to be able to predict the appropriate water management actions (water budget modeling) which will take into account droughts, flash flooding and reduced base flow.
- **Intra-basin transfers of water.** If permitted it would allow water power generating facilities to maximize the generation of electricity at existing facilities while minimizing impacts to the environment.
- **Water levels - Establish a process and criteria for approving water withdrawals.** The draft Annex 2001 issued by the Council of Great Lakes Governors has spurred a multitude of public comments regarding the decision making process for allowing withdrawals/diversions from the Great Lakes Basin. Although New York State currently has a permitting process for such withdrawals, more scientific data is needed to evaluate impacts on a multi-scale basis.
- **Bulk water removals.** Management of the lakes straddles federal/provincial/state jurisdictions and opinions differ on the impact of international trade law
- **Annex 2001.** The consequences it has on the future of the Great Lakes exporting water
- **Water quantity protection.** In light of dwindling fresh water resources - other regions may aggressively try to divert G.L. water - could dramatically alter hydrology of G.L.
- **Water diversions out of basin.** This is a precedent-setting issue. While the Western states are draining off the Colorado and other rivers, the Great Lakes states have managed to keep most of the Great Lakes water in the basin. Any water taken out of the basin sets a precedent, a trend, and a softening on water withdrawals that would escalate to turn the Great Lakes into the pathetic Colorado River trickle that enters Mexico. We need to acknowledge our carrying capacity and boldly stand up and say, "There is no more water. You must change your habits and use fewer resources."
- **Water regulation.** Consumptive uses could deplete resource
- **Science to support laws that protect ecosystem integrity and prevent export and diversion.** A lot of lip service is being given to the need to protect Great Lakes water resources over the long term from diversions and bulk export. These strategies all call for some sustainability strategies but are very thin on concrete conservation practices that could go a long way to demonstrate that Great Lakes communities are serious about doing their part to prepare for a water short world. These strategies could assist greatly in any trade challenges which could be bought to claim access to GL waters. The current Annex 2001 proposal made by the GL governors is not supported by the Province of Ontario and the Canadian governments because it is too vague on tangible conservation and protection standards. All lawyers who have looked at trade and water say laws based in sound science should be passed that fulfill the states and provinces right to protect the integrity of their water resources. Just how do we come up with sound science in time to see these protections in place within 21/2 years?
- **Ecological, economic, and social impacts of changes to water quantity and water quality.** The basis for present day decisions to ensure sustainable development.
- **Water quality/quantity.** Controversy about target nutrient and water levels and responses of aquatic and human populations.

- **Maintenance and supply of fresh/drinking water.** The vast majority of population growth in the next 35 years in Canada is projected to occur around the Great Lakes. Adjacent and surrounding communities rely on the Great Lakes for provision of safe drinking water and for treated sewage repositories. Due to inconsistent quality and quantity issues associated with ground water supplies, the Great Lakes are continually viewed as the "better alternative" for the provision of water. Licensing and permitting of water taking occur at the provincial level in response to local demands. Coordinated cross-municipality (or ecosystem) planning is virtually non-existent. In Ontario, proposals have been submitted to pipe Lake Ontario water, across communities that receive no benefit, to communities further afield that want to increase growth. Provision of consistent and safe water supplies are viewed as economic drivers and as the "engine for growth". The concern is that reliable data on taking large quantities of water from the Great Lakes has not been done in a way that is methodologically consistent across political jurisdictions. There is a need for consistent benchmarks and more research on the linkages of human behavior (social science) and the physical/natural sciences. While permitting and licensing occur in response to local demands, planning would benefit through the adoption of a larger perspective.

Water quantity: second most important issue

- **Water exports and diversions.** As pressure increases on sources of fresh water, so will pressure mount to take water from the Great Lakes.
- **Diversion of water from the Great Lakes and tributary watersheds.** The importance of water in the Great Lakes ecosystem cannot be overstated. Our freshwater resources are at the heart of this region's economy as well as its biological diversity. Diversions for human use, including groundwater extraction, surface water diversions, and removal of water from the five Laurentian lakes, has potentially detrimental impacts to the Great Lakes ecosystem. Excessive groundwater pumping can lead to catastrophe, in terms of lack of water to support human populations, but equally important, by threatening groundwater-supported ecosystems including karst landscapes, fens, streams, lakes, and wetlands, resulting in loss of species and natural communities. Depression of the water table dramatically alters the interaction between groundwater and surface water. Capturing groundwater flow that otherwise would have fed a nearby surface water body - a stream, lake, or wetland - diminishes the amount of water available to the surface water body.
- **Interaction of ground and surface water and groundwater mapping.** This is a great unknown in Great Lakes water management. It impacts decision making and planning to a very great extent
- **Diversion.** Diversion holds substantial potential to disrupt ecosystems on a massive and irreversible scale. This includes not only the lake systems, but also those systems depending on ground water.
- **Water Diversion Concerns.** Diversion of Great Lakes water resources may result in unanticipated environmental consequences that cannot be reversed.
- **What changes to the Great Lakes flow regime are necessary to restore and protect ecosystem health.** The flow of water through the Great Lakes ecosystem is a master variable of the system.

- **Water levels and flows within the whole basin.** Over the last few years, water levels have been recorded below long term averages. The whole vitality of the system depends on the quantity of water
- **Great Lakes water withdrawal, consumptive use, diversion and export.** Pressures for both in-basin and out-of-basin water withdrawal and consumptive use are increasing. Such proposals have both economic and ecological consequences, and decisions made in the near term could set precedents that have significant long-term implications.
- **Tribal water rights.** Transport of water out of the Great Lakes is being studied by more than one entity and tribes are largely being left out of the discussion regarding water rights. Tribes do have water rights, but there is no discussion about it with regard to moving water out of the Great Lakes
- **Preservation of stable Lake levels within appropriate ranges.** This is a purely technical concern related to design and operation of intake structures.
- **Ensuring that any Great Lakes water diversions do not significantly impact the system.** There are now and will continue to be significant pressures on existing freshwater resources around the world for human consumption. It is important that any out-of-basin transfers of Great Lakes water be weighed carefully, against possible longer term impacts on the Great Lakes system.
- **Relationship between global warming and GL water levels.** Exacerbated water levels (Both high and low) maybe increasing due to climatic shift and/or global warming. It is important to understand this relationship if we want to address GL water level management issues.

Water quantity: third most important issue

- **Water levels and water use.** The water levels of the Great Lakes plays a significant role in the use of these waterways. As the levels go down, this negative impacts shipping, recreational boating and other uses of these waters. If the levels go too high, negative impacts may occur, such as serious erosion.
- **Water Diversion.** Pretty obvious isn't it?
- **Water levels, e.g., Lake Ontario.** Ecological/environmental impacts of shifting water levels? Social/economic impacts of erosion of private property? Policy pathways for incorporating these considerations into the articles of agreement?
- **Management and use of Great Lakes waters.** We have a limited supply of water in the Great Lakes basin and the health of the ecosystem and those who depend on it is defined by both the quantity and quality of that water. Recent proposals to divert or sell Great Lakes water could have an extensive impact on the ecosystem and we do not currently have criteria or a framework under which to evaluate the wisdom of proposed or current uses and diversions of Great Lakes water.
- **Consumptive Use of Great Lakes Water Resources.** Toxic loadings in the Great Lakes pose as serious a threat to ecosystem and human health as the threat posed by consumptive uses but at least toxins have a somewhat rigorous legal regime controlling how much people are polluting the lakes now. There is still no good, strong, clear legal framework to protect the lakes from over-consumption. Ontario takes more water from the lakes than any other Great Lakes jurisdiction, and neither the provincial nor the federal government have adequately addressed consumptive uses of the lakes.

- **Lake water levels and climate change.** The influence of lake levels has important ecological and economic ramifications across the Great Lakes Basin and yet defining these ecological and economic ramifications is still in its infancy. Federal, regional, state, provincial, and tribal organizations are struggling to identify the appropriate approach to this complicated issue.
- **Water use.** Potential climate change and demographics in North America threaten water quantity and quality in the Great Lakes. Unwise water use in arid regions of the continent threaten catastrophic water shortages in those areas while increasing political clout in those areas threatens regional control of Great Lakes water.

Invasive species: most important issue

- **Prevention of introduction of exotic species by ballast water.** Impact that exotics have on the Great Lakes ecosystem
- **What measures should be taken to limit/minimize non-indigenous invasive species.** These place a huge strain on the existing ecosystems and make recovery from past abuses more difficult to achieve and to measure.
- **Continued invasion by non-native nuisance species.** The disruption to the Great Lakes Ecosystem, both water and land has been devastating. The science has clearly shown the nature of the problem, yet the invasions continue. The policies and procedures in place are not working, since invasions continue.
- **Aquatic nuisance species and ballast water.** 160 aquatic nuisance species(exotics) in GL basin. More on way, 17 from Ponto-Caspian Basin alone(Ricciardi and Rasmussen). Ballast water discharges, especially from NOBOB ships(No Ballast On Board) which are not subject to high seas exchange requirements, are still primary vector. Exotics present devastating challenges to GL ecosystem, especially fisheries and entire food web. May accelerate bioaccumulation of persistent, bioaccumulative toxics, too.
- **Continued introduction of invasive/non-native species which out compete endemic species.** These non-native species have replaced/displaced indigenous species that have existed here for thousands of years and are disrupting the lakes' ecosystems. The ecological risks posed by invading species directly translate to the disruption of the natural cycle upon which many species, especially humans, depend such as fishing, hunting, and gathering.
- **Impact of Aquatic Nuisance Species.** ANS impacts threaten the short-term and long term health of the great lakes eco-system.
- **Nonindigenous (nuisance) species in Great Lake water.** This biological pollution is having long-term impact on the integrity of the aquatic system.
- **Incidental introduction of Invasive species (unregulated ballast dumping & NOBOBs).** No federal mandates, and state legislative proposals being bushwhacked, resulting in continued critical declines in our bottoms-up food chain, loss of native phyto & zooplankton, and loss of habitat and native vegetation.
- **Unintentional introduction of exotic species.** It has completely altered the aquatic ecosystem, compromised the terrestrial ecosystem and species continue to be introduced via ballast water and other vectors.
- **Aquatic nuisance prevention.** _ * Exotic Species. Cost/benefit of control methods? Alternatives to dumping ballast water in lakes? How to stop spread?

Invasive species: second most important issue

- Ballast water technology

- **Introduction and control of spread of aquatic nuisance species.** ANS introductions are increasing in frequency and causing substantial damage to the nation's environment and economy. Aquatic ecosystems are threatened.
- **Invasive Species.** Substantial impact on ecosystem
- **Control of nuisance (exotic) species.** Once an exotic species gets established, they are very difficult if not impossible to eradicate. Their effects on the Lakes' ecosystems can be profound and long-lasting.
- **Prevent invasion of non-native species.** Non-native species have arguably been more destructive to the native fish fauna of the Great Lakes than any other single force. Construction of canals and intentional introductions allowed the first wave of invaders into the lakes. A new, rapidly spreading, second wave of invading species is associated with ballast-water discharges from ocean-going vessels. The worst of these invaders--quagga and zebra mussels, predacious zooplankton species, and round gobies--have the potential to profoundly alter food webs once they fully colonize the Great Lakes. Preventing entry is the foremost solution to this problem. Most invaders, once established, are difficult or impossible to control. Unwanted non-native organisms can also gain entry via the private culture of food fishes and via the aquarium and bait industries. Some introduction of non-native organisms for natural pest control, as with a recent attempt to control purple loosestrife with non-native beetles, may be beneficial when strictly and carefully implemented. Aside from exceptional circumstances when a net benefit to both ecosystem health and native species can be clearly established, no organism should be introduced intentionally into the Great Lakes basin. Effective safeguards against invasions require a strong and long-term commitment from governments and advocacy groups.
- **ANS.** ANS continue to drastically alter G.L. food webs and energy webs.
- **Methods to prevent invasion and/or impacts of aquatic nuisance or non-indigenous species.** Invasions are increasing as shipping and transportation increase and water quality across the globe improves
- **Invasive species.** The national awareness of aquatic invasive species and the problems they cause arose primarily from the costly unintentional introduction of the zebra mussel in the Great Lakes in the late 1980s and the subsequent spread throughout the eastern half of the country. The costs for treatment against zebra mussels in the Great Lakes alone are estimated at \$30 Million/year. Control treatment of the sea lamprey in the Great Lakes basin costs about \$15M/year. The annual economic costs of invasive species to the U.S. economy are estimated to be in the billions.
- **Introduction of exotic species by accident or intent and the related environmental effects** Society has tolerated what amounts to unintelligent tinkering with the environment by allowing introductions without a full knowledge of their effects.
- **Management of ballast water discharge.** continued introduction of new aquatic nuisance species is threatening environmental and economic health of Great Lakes; harmonization of US and Canadian ballast water standards; joint solution that involves all levels of government, particularly the federal governments since they have the regulatory responsibility
- **Invasive aquatic species.** Major and on-going source of negative ecological and economic impacts in the Great Lakes.

Invasive species: third most important issue

- **Will ballast water treatment be sufficient to protect the Lakes from future aquatic invaders?.** Aquatic nuisance species continue to wreak havoc on native species and habitats creating a costly imbalance in the system.
- **Controlling and preventing the introduction and spread of new invasives, especially exotics.** Invasive species can play havoc with ecological systems and have resulted in billions of dollars of economic and environmental damage. The well known effects of exotic, invasive species such as zebra mussel, purple loosestrife, spotted knapweed, carp, European Starling, and many others in the Great Lakes basin underscore the severity of the problem in both aquatic and terrestrial systems. Additionally, some native species, such as the white-tailed deer, have increased in numbers with severe consequences. Intact ecological systems are less likely to be colonized by both exotic and native invaders; maintaining unfragmented landscapes will likely decrease the incidence of invasion. Taking actions to prevent the further spread of invasive species will reduce loss of integrity to both ecological and economic systems in the Great Lakes basin.
- **Invasive species.** We are already seeing significant changes to the ecosystem that are likely the result of the introduction of new species.
- **Keep undesirable species out of the lake.** Zebra Mussels are a perfect example of what can happen. Other exotics have potential for similar problems. Ships coming in from foreign ports often carry exotic species in their ballast tanks.
- **control of exotic species.** expansion to other watersheds
- **Prevention and control of invasive exotic species.** Invasive exotic species (aquatic and terrestrial) displace native plants and animals, and disrupt the biodiversity of the Great Lakes ecosystem(s).
- **How and when should the ecosystem be intentionally opened to importation of biological material.** Intentional openings of the system are causing permanent and negative damage to ecosystem health
- **Impacts of current and potentially future exotic species invasions in the region.** Exotic species - from alewives to zebra mussels to round gobies, to purple loosestrife - have impacted the Great Lakes and surrounding areas significantly in the past century. Because of the immense impacts on food webs, biodiversity, and native species that these exotics can have, additional policy prescriptions are needed, both to address existing species of concern, as well as new species that could potentially be introduced in coming decades.
- **The presence of exotic Species.** Over the years, some 140 species have invaded the system, half of them being also present in the St. Lawrence. Some like the Zebra Mussel have a profound effect on the Lake Erie Ecology. We do not know what will be the combine effect of these species in the longer term.
- **Prevention and control of aquatic nuisance species.** The introduction and spread of aquatic nuisance species has had tremendous- and increasingly well documented- ecological and economic impacts. The success of prevention and control measures is fundamentally dependent upon a multi-jurisdictional approach based on sound science, economic efficiency and political acceptability.
- **Ballast water being released in the lakes - causing exotics to change the ecosystem of the lakes.** fish populations are dramatically altered, the entire ecology of the lakes is being altered.

- **Invasive species and fishing.** Great Lakes provide recreational and commercial fishing opportunities. The impact of invasive species on the sustainability of the fishery is unclear. How is the support of the sport fishery affecting the indigenous Great Lakes fish species.
- **Continued introduction of non-native biota to the Great Lakes system.** The ecosystem of the Great Lakes is continually being challenged by the introduction of non-native biota, whether it be unplanned as through ballast water or intentionally introduced through various non-native fish stocking programs. We are currently lacking both policy and technical tools to deal with the unplanned introductions. Similarly it is not clear that appropriate processes are in place to assess whether a new species should be introduced or be continued to be stocked into the system.
- **Relationship between aquatic populations/health and toxics and exotic species stresses.** There seems to be a growing relationship between stress on existing and introduced aquatic species with toxics and new introduced exotics. In order to management for introduced exotic species and reduction of trace toxic substances we need to understand these relationships better.

Development: most important issue

- **Economic/environmental sustainability.** Smart growth issues has impacts from local to federal level; imperative to economic growth and environmental enhancement/protection; expanding scientific understanding of function, biodiversity and economic importance of Great Lakes is imperative.
- **Shoreline and watershed development.** Has a direct impact on chemical, physical, and biological characteristics of the Lakes. Development is integrally related to non-point pollution issues. Existing and future land uses in the basin will dictate to large extent the magnitude of the problems.
- **Consistent dredged material management requirements.** There are inconsistent requirements for dredged material management between the states on the Great Lakes. In addition there are inconsistent requirements between in-lake and upland disposal of dredged material. While there may be scientific justification of differing requirements in some cases, it appears that oftentimes science may not be a consideration. Inconsistencies impact on ability to provide regional consistency for commercial and recreational navigation users and the customers they serve, and economically feasible as well as environmentally acceptable alternatives. The Great Lakes Regional Dredging Team has ongoing work efforts on this issue also.
- **Sustainable development - in terms of recreational use, homes, cottages and population growth.** If we fail to control the pressures we place on the Great Lakes systems and watersheds, we will have nothing but basins of dead water to float in. Quality of air and water and all associated ecosystems (right down to microscopic) must be carefully protected. The waterways can only handle so much recreational vessel traffic - this is from a safety perspective but also a shoreline erosion, shoreline development, waste exhaust into the water, trash in the water and the inevitable dumping of sewage from vessels plying Great Lakes waters, perspective. It all comes down to quality of life.
- **Balancing development and environment.** We are at a crossroads for this issue. We get competing demands to dredge and develop harbors, yet, no one wants the contaminated sediment put in their back yard in a cdf.

Development: second most important issue

- **Loss of habitat and biodiversity(land use).** Loss of habitat and biodiversity is threatened by continued urban/suburban growth as well as greenfields development at the expense of brownfield redevelopment. Nonpoint source pollution is also part of the threat due to many activities on the land and the increase in impervious surfaces. Both the "sprawl" aspect and the nonpoint source pollution aspect(diffuse runoff) are still not adequately addressed by policy, law or practice throughout the region. Economics of situation are not well understood either(e.g., benefits to builders of using less material, or value of impacted resources).
- **Land Use.** Urban sprawl and uncontrolled development have destroyed valuable habitat including wetlands and coastal marshes. New subdivisions require infrastructure such as sewage treatment, water, stormwater control, new/upgraded roads and contributes to a wide variety environmental degradation.
- **The changing nature of land use in the region.** There is a need to recognize the traditional culture and occupations that have shaped the region and how they will be impacted with new policy.
- **Changing demographics.** As human populations in the GLB age, we are likely to see a shift away from present patterns of settlement to settlement in heretofore unsettled, or sparsely settled areas in more Northerly areas of the basin. People will be seeking permanent retirement homes. This will put a strain on the fragile ecosystems of those areas.
- **Capitalizing on potential recreation, travel and tourism opportunities on the Great Lakes.** Some states, such as Ohio, are striving to identify the potential recreational opportunities that could be realized on the Great Lakes. This would be of significant benefit to our citizens' quality of life, and to providing positive opportunities for individuals who may otherwise select negative lifestyles, and to having a significant economic impact.

Development: third most important issue

- **Land Use/Sprawl.** Rapid growth and unplanned land use patterns are creating serious environmental problems. Wildlife habitat, water quality, wetlands, hunting, agriculture, and forestry are some of the entities threatened by land use patterns resulting from fragmentation. This includes the issue of damaging the exposed Great Lakes bottomlands with the low water, by riparian property owners.
- **Urban sprawl.** Urban sprawl relates to climate change issues, ground level ozone (smog), consumption of prime agricultural land, loss of endangered species.
- **Large scale commercial use of the waterways and the implications of that use.** Obviously, the Great Lakes witnesses a large volume of national and international shipping via the lakes and St. Lawrence. There are issues associated with the commercial use like waste, erosion, contamination etc. and other costs.
- **Effects of non-point runoff on the Great Lakes ecosystem.** With continued expansion of urban sprawl, run-off is increasing tremendously. It is very difficult, if not impossible, the fully understand the effects of such run-off on the Great Lakes water system.
- **Unplanned development in the watershed.** Non-point runoff is increasingly impacting the water quality of the Great Lakes and unchecked development may cause water quality problems that may take on the order of 1200 years (hydraulic retention time of Lake Superior) to reverse.

- **Vessel tracking technologies.**
- **To maintain commercial navigation but ensure its environmental responsiveness.** Great Lakes/St.Lawrence shipping accounts for the movement of 200 million tons of commodities each year and supports major segments of the regional economy.
- **Cumulative impacts of land use change on Great Lakes.** Population and economic growth lead to increased pressure on carrying capacity of environment
- **Sustainable development within watershed.** G.L. region will most likely continue to grow - if done in manner similar to past practices - will result in loss of ecological function, decreased water quality and significant loss of quality of life.

Ecology: most important issue

- **Increase mechanisms (especially incentives) for implementation of ecosystem-level management.** Ecosystems in the Great Lakes region occur at multiple scales. Regardless of scale, most ecosystems share certain properties: they include a complex interaction between biotic and abiotic factors, are made even more complex when humans and human activities are considered part of the system. Therefore, at any scale, ecosystem-level management needs to consider the complex interactions between land, water, and biota, both human and non-human. Unfortunately, the spatial and temporal complexity associated with this kind of planning effort often precludes any attempts from taking into consideration the interactions among natural resources (e.g. forests, streams, wetlands, multiple taxonomic groups, wide-ranging species) in management planning. As a result, resource management is often uncoordinated and resource-specific; it does not adequately address the myriad interactions among our natural resources and the potential, indirect impacts that individual management activities may have. Yet the ecological and economic viability of the Great Lakes region depends on the integrity of Great Lakes ecosystems and not just on condition of individual resources. Many public and private organizations play various roles maintaining the ecological and economic viability of the Great Lakes region. Many industries, including tourism, recreation, forestry, agriculture, and shipping, depend heavily on how our natural resources are managed. The Great Lakes community should support development of policies that encourage cooperative land and water management efforts that address both ecological and economic priorities.
- **Habitat Conservation.** Funding of habitat conservation projects provides direct public access to government investments on the lakes and can serve as tools for educating people about other issues.
- **Conservation of Habitat.** Losses of physical habitat critical to fish and other aquatic organisms continue in the Great Lakes even though development of Great Lakes shorelines and river flood plains is regulated by governments. Much aquatic habitat, just like the fish that depended on it, vanished in the 1800s before it was inventoried or its value understood. Clearly, those aquatic habitats whose supply has been most diminished are now all the more valuable owing to their scarcity.

Problems of protection and rehabilitation appear nearly insurmountable because of a diffuse regulatory structure and an absence of reporting loss in relation to supply. Rivers are particularly hard to protect because development of uplands, well away from floodplains, affects hydrologic cycles that control fish composition and abundance. Our organization strongly endorses a goal of no loss of essential fish habitat; however, this goal cannot be achieved until a comprehensive system of classification and inventory is in place on each Great Lake. Because of the enormity of this task, first priorities for classification and inventory should be given to vegetated near-shore areas and to rivers, especially those rivers less altered and still supporting assemblages of native fishes. The goal of organizing and initiating an interagency effort to protect and restore habitats logically flows from the classification and inventory of habitats. Our organization understands that developing a workable system of classification and inventory and getting environmental regulators to then use it is a very ambitious undertaking. Nonetheless, the achievement of this goal is critical for preventing loss of essential habitats.

- **Maintaining ecological integrity within the Great Lakes basin.** This issue is critical because it cuts across all the other GL management issues and is connected to management stewardship and effectiveness of GL management.
- **Integrity of the Great Lakes Ecosystem.** All uses depend on a healthy lake ecosystem with clean water, abundant habitats and self-sustaining fish and wildlife populations
- **Ecosystem Restoration.** It puts the resource first and allows resource managers to respond to evolving needs of the ecosystem

Ecology: second most important issue

- **Attenuating additional physical, biological and chemical stresses on the ecosystem.** We need to adopt a nondegradation strategy relative to invasive, chemical pollutants and physical stresses on the system (like habitat destruction) so that we do not fall farther behind in ecosystem restoration as we invest in clean-up and response to past insults to the system.
- **Ecosystem restoration.** Much contamination from years of heavy industrial development.
- **Need better monitoring for wildlife/ecosystem health.** Monitoring programs have been cut in US and Canada, and we do not have enough data on what's actually happening to fish and wildlife in the basin. Research has become heavily weighted towards computer modeling, with fewer people in the field researching wildlife effects, or making their findings publicly accessible.
- **Habitat Loss and Degradation.** We continue to have a net loss of habitat quantity and quality. And have not included "design with nature" as part of our development planning.
- **Management of Coastal Resources.** Better science on management of coastal resources is needed to allow better management of those resources on a regional level, considering wetland management, shoreline erosion, sand management, sediment reduction, ecosystem restoration, etc. Better long term regional treatment is needed to avoid continuing local short term reaction to problems in the continually changing lake environment.

Ecology: third most important issue

- **Clean-up and response to past/existing problems.** The system will not return to health without attention to past insults to the system such as contaminated sediments, established invasive species, hydrogeological barriers and shoreline development
- **Threats to ecosystem habitat.** Considerable effort and money is going into restoring and protecting the natural habitat and biotic communities of the Great Lakes basin to some "desired state of health." To improve management of these efforts, increasing knowledge is needed to identify natural/evolutionary trends or changes from human-induced changes and to predict future threats and their potential impacts.
- **Clean up of Detroit River and AOCs.** efforts in the past have achieved limited success on the Detroit River. Co-ordination of all interested parties and organizations is a challenge.
- **Achievement and maintenance of Stream and Lake quality.** The integrity of stream ecosystems is imperative to achieving lake quality. Current pollution control practices and "urban sprawl" threaten to degrade the biotica of the quality streams while pollution control practices to not return degraded waters to high quality status.
- **Public support for clean water and healthy lake ecosystems.** People need to see personal and collective value from a healthy ecosystem

Governance: most important issue

- **The absence of a recognized process for setting Sustainable Development priorities.** The current helter-skelter approach(excepting SOLEC)commits large amounts of resources and effort, especially toward environmental objectives, without the ability to asses relative risks/returns.
- **Multi-jurisdictional governance structures.** Determines how issues are addressed.
- **Jurisdiction over Great Lakes water.** States have conducted a number of activities that have compromised the quality of Lake Superior waters. They are now considering allowing water to be removed from the Great Lakes by "contractors" and other states. These decisions are being made without input from or regard to Indian tribes in the Great Lakes system. Indian tribes should have the same rights, or greater, than states to decide how the waters of the Great Lakes should be used. Many tribes near the Great Lakes use them for subsistence fishing.
- **That First Nations are included in Great Lakes policy development.** Our agency mandate is to improve First Nation environments and develop capacity leading toward self government.
- **Renewal Of the Canada/Ontario Agreement.** Because the COA, especially its most recent (and lapsed) version, stands, albeit imperfectly, as the mechanism that has so far achieved some really impressive results in protecting, restoring the Great Lakes and improving public understanding of/involvement with Great Lakes water quality and ecosystem health.
- **Water Use data management.** Getting better use data from around the region would assist in better water use planning and decision making
- **Cooperation among agencies to ensure safe boating.** Because of limited resources, it is imperative that agencies with overlapping missions and goals to work together and support each other where possible. Ultimately, the public benefits.

Governance: second most important issue

- **Safety - of boaters on the waters.** Can the great Lakes handle more boats, different types of watercraft and faster boats on the lakes. Can CCG respond to the demands of the clients in terms of safety, environmental response, aids to navigation, marine radio communications... can our services, resourced as they are, meet demands. And if not, is the safety of boaters, vessels and their cargos and therefore the environment at greater risk?
- **The frequent assumption that impacts are due to anthropogenic activity and not natural.** It is assumed that changes and abnormalities in the ecosystem are due to human effects. In fact there are many causes such as climate variations, introduced species and natural 'diseases' that can causes influences.
- **Should Annex 2 of he GLWQA be revised to allow for delisting prior to restoration of BU?** Policy debates in the US are divided on this issue. Some jurisdictions believe that delisting should occur when all remedial actions have been implemented even if beneficial uses will take years (or decades) to be restored. Other jurisdictions concur with Section 4c of the Annex which states that delisting shall occur when beneficial uses have been restored. (Note: the above question refers to delisting when all remedial actions have been implemented but beneficial uses have not been completely restored.)
- **Development and implementation of the Lake Superior Lakewide Management Plan.** Lake Superior's biological, physical, and chemical integrity must be protected and restored to protect the Tribes' fishing and other treaty rights that apply in the Lake Superior basin. These rights are meaningless if the natural resources subject to them are contaminated or if they disappear.
- **Cooperation among bordering states to standardize enforcement of regulations.** Illinois' portion of Lake Michigan is relatively small. Because of this, boaters and fishermen from Indiana, Wisconsin, and Michigan often cross boundaries several times in a day on the lake. Regulations often differ and licenses are required in each state. Boaters often do not know where boundaries lie.

Governance: third most important issue

- **International Cooperation.** Cooperation allows two federal jurisdiction in numerous state/provincial jurisdictions all to be rowing in the same direction. Doing something good on one side of the river or lake is certainly countered out by not doing it on the other - or worse doing detrimental. This could be in terms of safety (SAR coverage) or pollution limits or development or... so cooperation is key - there are no borders in the water...
- **Cultural traditions.** Cultural traditions in the Great Lakes region are both unique and diverse, yet many are commonly shared. The challenge is how cultural traditions can be more explicitly factored into the co-management strategies we devise for Great Lakes ecosystem management.

Use/role of science: most important issue

- Our agency supports the creation and sharing of knowledge for balanced decisions about Canada's landmass and resources. A key science-policy driver in our agency is the development of geoscience knowledge needed to address a variety of Great Lakes issues (e.g. groundwater dynamics, lakebed contaminants, ecosystem habitat, marine archeology). For example, one of our operative units builds and maintains a geoscience knowledge base as a framework for land-use decision making and environmental assessment related to ensuring sustainable development. In the Great Lakes, a geoscience knowledge base, which includes bedrock configuration, type and structure, sediment stratigraphy, chronology, and physical and chemical properties, is needed for assessment of diverse issues including groundwater circulation between onshore and offshore, evaluation of contaminated sediments and waste materials, ecosystem habitat mapping, assessment of underwater historic cultural heritage sites, etc. This knowledge is used to carry out our responsibilities through consultation with stakeholders in the provinces and territories, industry, academia, and other federal departments, and in keeping with the Canadian Intergovernmental Geo-science Accord. For the bi-national Great Lakes, these consultations would also include equivalent agencies in the United States, and the International Joint Commission, where appropriate. The health of fisheries and related biological resources depends on the management and quality of lakebed habitat, and is one example of the potential application of geoscientific mapping in the Great Lakes. In partnership with other government departments and industry, our agency develops and operates high-resolution mapping systems, for example new multi-beam acoustic mapping technology, and conducts research to better understand the relationship between fish resources and lakebed properties derived from the mapping activity. It is anticipated that application of similar operations in the Great Lakes under a new SEAMAP program will contribute knowledge for managers of lakebed habitat to maintain and improve the quality of fish resources and lake ecosystems. Another example concerns water resource evaluation. Our agency operates a national program, in partnership with federal and provincial agencies and others, to map major groundwater aquifer architecture, and to model surface and subsurface waterflow in the context of water as a sustainable resource. In the Great Lakes drainage basins the groundwater systems likely flow to the lakes, and knowledge of the groundwater flux would be beneficial to understanding the dynamics and magnitude of the groundwater resource where human activity is a significant user.
- **Use of Improper Data Trends Analysis Protocols.** Currently data trends analysis and presentations are generally done using linear plots. However, the decay rates are usually first order relationships. Erroneous conclusions are frequently drawn regarding contaminant trends and their rates of decline.
- **The connection between cultural perspectives and science policy.** Given the changing population in the region it will become increasingly important to take into account the various cultural perspectives of those in the region as policy is developed.
- **Better Interpretation of Environmental Data.** Society has expended extensive resources on cleaning up the Great Lakes and will continue to do so. These resources must be applied where they will do the most good. A correct interpretation of how well we are doing is critical to making future policy choices. Incorrect interpretation on trends will result in poor decision-making.

- **Implement the findings of past funded research on water and biotic quality.** The public needs to see that past funded research is put to good use. The resources need attention now, to prevent degradation.
- **Use of sound or peer reviewed science including good data interpretation techniques and statistics.** Some work is conducted and analysis is interpreted on limited scientific data. This may be through extrapolation of data from one area to another without validation. Accumulations and decays are based on simple scientific tools such as linear relations when in fact they are complex interacting and non linear. Also confounding influences (sometimes of natural origin) are not accounted for.

Use/role of science: second most important issue

- **A self-serving, credibility-lacking academic and politically-based science community.** Politically motivated fish consumption advisories, lacking uniformity on a nation-wide basis, and paranoid scare tactics used to promote only the bad without giving equal weight to benefits. Critical loss of food chain resulting in reduced numbers of forage and prey fish lack the steam needed to get the concern of state and federal legislators. Again a possible credibility problem. Science is always crying wolf and only the bad is shared with the general public, to be sure the annual budget is always renewed or enhanced.
- **Use of science based communications to react to environmental anomalies.** When environmental anomalies are observed (i. e. deformed frogs or other unusual events) there can be a rush to judgment in order to explain the observation, and its “causes” to the public. Scientific explanations are often bypassed in favor of a quick answer which will better satisfy public demands for immediate casual explanations. Answers become based on speculation rather than science based information. Although corrected later, the “final answer” is often lost in the hype associated with the initial diagnoses-even when incorrect.
- **Constructively utilizing results of new environmental research and 'in field' findings.** 'Announcements' of new findings defocus attention/effort/resources from priorities.
- **Developing the scientific knowledge needed to keep conservation practices and systems effective.** A strong scientific basis is needed for all conservation practices and systems of practices. In many cases, it is difficult to keep updated with local and regional research to make improvements in conservation practices.

Use/role of science: third most important issue

- **Use of peer review processes to define environmental issues.** Environmental issues often evolve, or become framed from, hypotheses advanced by single or associated groups of scientists. Peer review and consensus needs to be built within the broader scientific community if these issues are to receive the broad stakeholder support needed to assure resolution.
- **Environmental policy processes and peer review.** The lack of consensus amongst scientists leads to political postures in stead of collectively addressing the issue at hand. Great Lakes environmental issues could be better addressed by a strict adherence to all the principles of the Scientific Method , including peer review, which would help build a much needed and at least scientific consensus.

Climate change: most important issue

- **Regional impacts of climate change.** Anthropogenic inputs appear to be having an influence on regional temperatures and precipitation already and these effects will certainly increase in the future. Concerns about water resources and lake ecology clearly need to be incorporated into global, as well as regional policy.
- **The impact of climate change.** Climate change is the most important issue on earth. There will be major direct and indirect impacts on the Great Lakes.

Climate change: second most important issue

- **Climate change.** It will dictate availability of resource.
- **Climate change.** The impacts of climate change could be potentially -- given the stresses they are currently under -- devastating for the lakes and the human communities that rely on them.
- **Climate change impacts.** In establishing Canada as a global model for resource stewardship and environmental responsibility, our agency has the lead for the domestic implementation of federal policies and measures to reduce greenhouse gas emissions (e.g., through the National Climate Change Implementation Strategy). Our agency's expertise in energy, forestry, mining, earth sciences and remote sensing, enables us to contribute to research regarding the reduction of climate change impacts. Our agency, along with federal environmental agencies, is responsible for the co-management of the science, impacts and adaptation element of the Climate Change Action Fund with the objectives of (1) understanding the earth science aspects of the impacts of climate change and extreme climate events on Canada arising from increases in the concentration of greenhouse gases in the global atmosphere, and (2) with partners, developing strategies to minimize and adapt to these impacts. The role of the GSC is to provide fundamental geoscience knowledge on past climate, relevant data on current climate trends, and research information related to the impacts of climate change and possible adaptation. As future scenarios for the Great Lakes generally suggest warmer and drier conditions, it is important to understand the impact on the region's hydrological water balance, possibly resulting in lower lake levels and related changes, some with adverse socio-economic consequences.
- **Global climate change.** Affects the environment surrounding the Lakes including lake levels, temperature, productivity etc.

Climate change: third most important issue

- **Global warming.** Global warming effects may be the single most important source of impacts to habitat, water quality and human health in the Great Lakes.
- **Water use.** Potential climate change and demographics in North America threaten water quantity and quality in the Great Lakes. Unwise water use in arid regions of the continent threaten catastrophic water shortages in those areas while increasing political clout in those areas threaten regional control of Great Lakes water.

- **Lake water levels and climate change.** The influence of lake levels has important ecological and economic ramifications across the Great Lakes Basin and yet defining these ecological and economic ramifications is still in its infancy. Federal, regional, state, provincial, and tribal organizations are struggling to identify the appropriate approach to this complicated issue.

Fisheries: most important issue

- **Implementation of the Joint Strategic Great Lakes Fishery Management Plan.** This relates to Indian Tribes' treaty-guaranteed fishing rights and the recognition of Tribes as co-equal governmental partners in the regulation and management of fisheries that are subject to those rights.
- * **Fisheries, e.g., smallmouth bass vs. DC cormorants.** What are the feeding patterns of DCC? Migration w/i flyway? Travel patterns w/i Lake Ontario? Other factors influencing smb populations? Level of bioaccumulated contamination in DCC?

Fisheries: second most important issue

- **Maintaining fish stocks and the recreational base for the region.** The Great Lakes are one of the major economic resources of the region and result in a large influx of money from other regions that clearly bolsters the economy of states like Michigan.

Fisheries: third most important issue

- **Protection of Aboriginal fishing rights.** For the preservation of traditional uses, community sustenance and commercial opportunities for First Nations.
- **Fisheries management.** Contributions to the upstate (NY) economy.
- **Declining populations of natural resources due to interference from political sources, leading to su...** If we don't wake up and accept the responsibilities of our actions - and do something about them - we won't have any natural resources left. They will be replaced with exotics.

Appendix 7: List of Participants, Great Lakes Science-Policy Initiative, Policy Advisory Board Meeting, June 13, 2001

Holly Arrigoni, Loyola University of Chicago

Paul Bertram, U.S. Environmental Protection Agency-GLNPO

Steve Blasco, Geological Survey of Canada

Stephen Bocking, Trent University

Sue Brauer, U.S. Environmental Protection Agency, Region V

Jim Bredin, Michigan Office of the Great Lakes

Joel Brummeier, Lake Michigan Federation

Pat Chau-Fraser, McMaster University

Bill Christensen, University of Wisconsin-Milwaukee

Laura Cimo, Michigan State University/Knauss Sea Grant

Cameron Davis, Lake Michigan Federation

Joe DePinto, Limno-Tech, Inc.

Dean Fitzgerald, Cornell University

John Gannon, U.S. Geological Survey

Sharon Hansue, Michigan Dept. of Natural Resources, Fisheries Division, Great Lakes Fisheries Trust

Bud Harris, University of Wisconsin-Green Bay

Vicky Harris, Wisconsin Sea Grant

John Hartig, Greater Detroit American Heritage River Initiative

Don Hughes, State University of New York-ESF

Joe Koonce, Case Western Reserve University

Brent Lofgren, Great Lakes Environmental Research Laboratory

Jon MacDonagh-Dumler, Great Lakes Commission

Christine Manninen, Great Lakes Commission

Gerald Matisoff, Case Western Reserve University

Trefor Reynoldson, National Water Research Institute

Bill Richardson, U.S. Environmental Protection Agency

Karl Schneider, University of Toledo

Steve Schneider, University of Michigan

Sue Senecah, New York Coalition of Great Lakes Legislators

Harvey Shear, Environment Canada

Saulius Simoliunas, Detroit River Remedial Action Plan Council

John V. Stone, Great Lakes Science-Policy Initiative Survey Manager, IAGLR (in absentia)

Rochelle Sturtevant, Michigan Sea Grant/Great Lakes Environmental Research Lab

Dan Thomas, Great Lakes Sport Fishing Council

Rich Thomas, International Lake Environment Committee

Mike Zarull, National Water Research Institute