State of the Lakes Ecosystem Conference 2002

Conference Proceedings

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Table of Contents

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1. Introduction

1.1. What is SOLEC?

The State of the Lakes Ecosystem Conferences (SOLEC) are hosted by the U.S. Environmental Protection Agency and Environment Canada on behalf of the two countries. These conferences are held every two years in response to a reporting requirement of the binational Great Lakes Water Quality Agreement (GLWQA). The goal of SOLEC is to achieve the overall purpose of the GLWQA "*to restore and maintain the physical, chemical and biological integrity of the Great Lakes Basin*". The conferences are intended to report on the state of the Great Lakes ecosystem and the major factors impacting it, and to provide a forum for exchange of this information amongst Great Lakes decision-makers. These conferences are not intended to discuss the status of programs needed for protection and restoration of the Great Lakes basin, but to evaluate the effectiveness of these programs through analysis of the state of the ecosystem. Another goal of the conference is to provide information to people in all levels of government, corporate, and not-for-profit sectors that make decisions that affect the Lakes.

These conferences are a culmination of gathering information from a wide variety of sources and engaging a variety of organizations. In the year following each conference, the Governments prepare a report on the state of the Great Lakes based in large part upon the conference process.

The first conference, held in 1994, addressed the entire system with particular emphasis on aquatic community health, human health, aquatic habitat, toxic contaminants and nutrients in the water, and the changing Great Lakes economy. This conference and SOLEC 1996 were based on a series of ad hoc indicators that were suggested by scientific experts. The 1996 conference focused on the nearshore lands and waters of the system where biological productivity is greatest and where humans have had maximum impact. Emphasis was placed on nearshore waters, coastal wetlands, land by the Lakes, impacts of changing land use and information availability and management. Following SOLEC 96, those involved identified a need to develop a comprehensive, basin wide set of indicators that would allow the Parties to report on the progress under the Agreement in a compatible and standard format.

For SOLEC 98, the indicator development process became more regimented with the development of a comprehensive suite of easily understood indicators that objectively represent the condition of the Great Lakes ecosystem components (as called for in Annex 11 of the GLWQA). The goal is to use these indicators every two years to inform the public and report progress in achieving the purpose of the GLWQA, thus initiating a regular and comprehensive reporting system. This indicator suite would draw upon and compliment indicators used for more specific purposes such as Lakewide Management Plans (LaMPs) or Remedial Action Plans (RAPs) for Areas of Concern. During SOLEC 98 and afterward, the suite was thoroughly reviewed and a general consensus was obtained that the suite of 80 indicators was necessary and sufficient.

Following the general acceptance of the Great Lakes suite of indicators was the movement to begin implementing them. At SOLEC 2000, the challenge was to see how many of the 80

indicators could be reported on. In some cases this was a fairly "easy" task – data were already available for use in reporting on an indicator (by various agencies). In other cases, this task became more difficult as new data were required before they could be reported, or further research and development was required before implementing data collection efforts and then reporting on an indicator. Post SOLEC 2000 and through the winter of 2001, there was an opportunity for further review of the indicator list and for revisions to be made to the indicator suite. SOLEC 2000 was the first conference to begin the actual assessment of the state of the Great Lakes using these science-based indicators.

1.2. Purpose of SOLEC 2002

The focus of SOLEC 2002 was to continue to update and assess the state of the Great Lakes using the current suite of indicators with an emphasis on biological integrity, the theme for SOLEC 2002. "Integrity" is not specifically defined in the GLWQA; therefore the following definition was used for SOLEC 2002 and any corresponding documents.

> *"Biological integrity is the capacity to support and maintain a balanced integrated and adaptive biological system, having the full range of elements (the form) and process (the function) expected in a regions natural habitat."*
> By James R. Karr, modified by Douglas P. Dodge

SOLEC 2002 presented the most comprehensive assessment yet of the state of the Great Lakes basin ecosystem. SOLEC 2000 featured 33 indicator assessments, and this year the number of reported indicators has grown to 43. A draft version of this report (Implementing Indicators and the Addendum) was distributed at SOLEC 2002. The comment and review period for this indicator assessment report, was available on-line until January 2003.

Since SOLEC 2000, significant development work has taken place. SOLEC 2002, presented a candidate set of Biological Integrity indicators, in addition to groundbreaking work that has been done on land-based indicators: agriculture and forestry. Also, a new suite of indicators was proposed for consideration to assess groundwater health. A new grouping of cutting-edge societal response indicators was also proposed to help in the assessment of community contribution to improving the health of the basin. SOLEC 2002 also provided revisions to current indicators in the Great Lakes suite and identification of management challenges and actions.

1.3. Next Steps and Challenges

The challenges of SOLEC 2002 and beyond are to prepare a list of indicators that integrate information collected at all trophic levels in the basin. This integration will provide indicators to measure the state of biological integrity in the Great Lakes.

The following are next steps and challenges that developed from SOLEC 2002:

- Further incorporation of Traditional Ecological Knowledge (TEK) into the assessments of Great Lakes indicators of health.
  Some suggestions included:
  - Reviewing other projects that combine Traditional Ecological Knowledge and Western science such as the Ashkui Project. For more information visit: (http://www.ec.gc.ca/EnviroZine/english/issues/26/feature2_e.cfm)
- Sampling of tributaries and inland surface water bodies should be used in assessing the state of the Great Lakes basin through a "watershed approach".
- A need was identified to incorporate more terrestrial components into existing Great Lakes indicators.
- The idea of an overall Great Lakes Index should be further pursued, possibly using the Canadian Biodiversity Index proposed by Risa Smith and Wayne Bond of Environment Canada, as an example.

- The proposed indicators for groundwater, agriculture, forestry, and for climate change from SOLEC 2002 need to be reviewed and accepted in order to ensure adequate reporting and assessment for SOLEC 2004.
- Need to re-evaluate and re-organize the societal response indicator suite proposed at SOLEC 2002.
- Need to populate the proposed Biological Integrity indicators from SOLEC 2002 for reporting and assessment at SOLEC 2004.
- A continuing challenge is to increase ownership and commitments to indicator reporting – some agencies have accepted lead roles for the responsibility of preparing biennial indicator reports, however, many of the indicators are still awaiting "adoption". More agencies assuming ownership of indicators will aid in populating and reporting on the state of these indicators.
- As stated in the State of the Great Lakes 2001 report, it was noted that many of the indicators still do not have an associated endpoint, target or reference value. A lack of endpoints is still a recurring challenge.
- Need to bring more social scientists into the indicator process, especially in terms of human response indicators.
- A Peer Review workshop for the Great Lakes indicator suite has been proposed for the Fall of 2003.
- The theme for SOLEC 2004 is Physical Integrity and work will be planned and implemented to assess the state of physical integrity in the Great Lakes basin over the next two years.

2. SOLEC 2002 Highlights

Conference Results

- SOLEC 2002 presented the most comprehensive assessment yet of the state of the Great Lakes basin ecosystem. SOLEC 2000 featured 33 indicator assessments, and this year the number of reported indicators has increased to 43. This increase in indicator assessments reflects the increased effort of SOLEC to encourage the reporting process, and thus increase active participation.
- New Biological Integrity, land-based (forestry, agriculture, and groundwater), and societal response indicators were proposed.
- SOLEC 2002 maintained the strong link forged between LaMP, RAP and SOLEC work. This conference had LaMP and RAP groups provide presenters for the individual state of the Lake plenary presentations. In addition these groups also provided assistance to the development of the biological integrity research presented at SOLEC 2002.
- This was the first SOLEC to host a special session attended only by managers within the Great Lakes basin. This managers session was designed to discuss Great Lakes research and monitoring needs to assist in future decision-making and management challenges.

Suggestions from Conference Participants

- Need to consider indicators of good health or healthy communities; too much emphasis on "death and dying" indicators.
- Suggest that SOLEC monitor Brominated Flame Retardant and Endocrine Disrupting Chemical (EDCs) research for the purpose of tracking health related indicator trends.
- Suggest that the indicator grouping "unbounded" be better defined, and it could possibly be linked to climate change.
- New atmospheric indicator was suggested in order to develop a common alerting and indicative system for smog advisory along the U.S.-Canada border; including the Great Lakes basin.

3. Conference Opening

Harvey Shear
SOLEC Co-Chair
Environment Canada, Ontario Region

[HARVEY] Welcome to the 5th Biennial State of the Great Lakes Ecosystem Conference, sponsored by the Governments of Canada and the United States. These conferences are designed to be interactive, to maximize delegate discussion and scientific feedback, and to provide insight into emerging trends.

This year, SOLEC will present the most comprehensive assessment yet of the state of health of the Great Lakes basin ecosystem. SOLEC organizers are proud to be reporting on the assessments provided from 43 indicators. Clear trends can be identified in the state, pressure and response assessments. Since SOLEC 2000, significant development work has taken place. A candidate set of Biological Integrity indicators will be presented on Day 2. Further groundbreaking work has been done on the land-based indicators: agriculture and forestry. And, a new suite of indicators is proposed for consideration to assess groundwater health. The new groupings of societal response indicators are cutting edge, when it comes to assessing community contribution to improving the health of the system.

This year's conference will go a long way to answering the public's prevailing questions: Can we eat the fish? Can we drink the water? Can we swim in the Great Lakes? Is the air healthy to breath? And, the opportunities and challenges that lie ahead.

After listening to all the presentations, you are invited to review the organizers' work, and enhance their findings with your insight and knowledge. Your knowledge will inform the Governments' State of the Great Lakes Report to be produced in the summer of 2003. Your participation in SOLEC 2002 represents an important contribution to our efforts to meet the goals of the Great Lakes Water Quality Agreement.

4. Plenary Presentation Summaries

The 16 plenary presentations at SOLEC 2002 covered many topics that explored the most important questions related to the health of the Great Lakes ecosystem: Can we drink the water? Can we eat the fish? Can we swim in the water? The underlying focus of the presentations was Biological Integrity, the theme of SOLEC 2002.

Day 1 – Reporting on the State of the Great Lakes

Plenary: Great Lakes Ecosystem: State, Pressures, Challenges and Opportunities

Day 1 focused on highlighting the current state of the Great Lakes basin ecosystem, the pressures impacting on the health of the system, (including: non-native species, toxic contaminants, excessive nutrients and certain physical processes) and the challenges and opportunities for improving the state of the system for the future. In terms of looking at the state of the ecosystem, the questions being asked include: "Can we eat the fish? Can we swim in the water? Can we drink the water? Can we breathe the air?"

The future pressures to the Great Lakes ecosystem were also discussed on Day 1 of SOLEC 2002. Two of the most serious challenges within the Great Lakes are non-native species and urban sprawl.

And lastly, management implications were discussed to determine the next steps to improve the state of the ecosystem in the future.

Day 2 – Indicator Development

Plenary: Biological Integrity and Societal Response

The opening plenary presentation on Day 2 focused on Biological Integrity. New indicators, emerging issues and ideas for protecting the biological integrity of the Great Lakes basin ecosystem were detailed in this presentation. Biological integrity of a system is important as it can be described as the "glue" that integrates biological systems. Integrity gives biological systems the capacity to recover from most natural disturbances. Doug Dodge presented the proposed Biological Integrity indicators for the Great Lakes suite. After a workshop on Biological Integrity and a survey of Lake experts, four categories of new biological indicators were established:

1. Indicators addressing the impacts from non-native species
2. Indicators that track changes in communities
3. Indicators measuring habitat quality and quantity
4. Indicators concerned with contaminant pathways

This presentation emphasized that "species extinction is forever; but so is the introduction of non-native species". The future pressures on the biological integrity of the Great Lakes basin include the impact of non-native species, habitat modifications, nutrient quantity and quality; in addition to a recent increase in the number of Type E – Botulism cases in fish and bird species in the basin.

Two case studies were also presented in addition to the proposed suite of Biological Integrity indicators. Patrick Colgan discussed a Canadian example of restoring the biological integrity of an ecosystem; Cootes Paradise and Grindstone Creek Marshes. These restoration efforts are an element of the Hamilton Harbour Remedial Action Plan. The methods used to restore and increase the biodiversity at this site include:

- Limiting non-native species;
- Wetland replanting;

- Stream channel rehabilitation;
- Monitoring;
- Support of watershed stewardship programs; and
- Education

Wendy Hinrichs Sanders presented an example of sustainable forest management by the Great Lakes Forest Alliance on the U.S. side of the basin. This project is designed to promote sustainable forest management through the integration of ecological, economic and social criteria.

Day 2 also included a presentation on new Societal Response indicators. Laurie Payne presented a new suite of societal and societal response indicators that are based on the interface between human and natural systems. The importance of reporting out on societal indicators was presented. These indicators help to reinforce the linkages between societal activities and the state of the ecosystem so we can determine the most effective management activities and ways to inform and implement public policy initiatives. These indicators seek to measure both human activities and their impact on ecosystem health and measure human response to ecosystem pressures.

Societal Response indicators recognize that all residents, businesses and governments have a role to play in protecting our ecosystem health. These indicators have been developed in consultation with experts in the field and through workshops and first nation consultation. In total there are 11 proposed indicators which fall under the following categories:

1. Institutional
2. Community/Household
3. Industrial/Commercial
4. Cross-Cutting

SOLEC 2002 also expanded its horizons by including additional indicators for the Great Lakes indicator suite. Day 2 also presented work on SOLEC's ecosystem approach to Great Lakes reporting, i.e. which work has been broadened beyond the Lakes themselves to the entire watershed, including streams and rivers, groundwater, farmland, forests and urban areas. Proposed indicators for the Great Lakes indicator suite were presented for groundwater, agriculture and forestry.

The proposed groundwater indicators, presented by Norman Grannemann, help to address Annex 16 of the Great Lakes Water Quality Agreement. Indicators were selected for which data are available or which can easily be collected. These 7 indicators are designed to evaluate the status and trends of groundwater resources related to both availability and quality of groundwater resources. The range of indicators are looking at how much groundwater we use to meet human and ecosystem needs, how much groundwater discharges to streams, the changes in groundwater quality, interactions between land use and groundwater quantity and quality, and how to manage groundwater resources.

The proposed agricultural indicators include: Integrated Pest Management, which would report on the adoption of integrated pest management practices. The second proposed agriculture indicator would measure the number of Nutrient Management Plans in place. This indicator would help to manage the amount, form, placement and timing of applications of nutrients for uptake by crops as part of an environmental farm plan.

Norman Grannemann also presented the new proposed forestry indicators developed by the Great Lakes Forest Alliance. These indicators include the percentage of forest area in each cover type, abundance and trends of rare, threatened or endangered species, trends in area of forest land, fragmentation of forest types, forest land ownership and forest employment by sector.

Day 3 – Focus on Individual Lakes
Plenary: Lakes, Rivers and Fishery Reports

The plenary session on Day 3 of SOLEC included presentations on the state of each lake basin and river system and the pressures on the basins' biological integrity.

Lake Ontario

Rimi Kalinauskas, Environment Canada, presented highlights of the assessment of the state of Lake Ontario, including the reduction of contaminants in edible fish tissue, loss of agricultural land and rapid urbanization.

Lake Ontario was referred to as an "ecosystem in transition" and the most important issues affecting the biological integrity of the lake are:

1. Chemical Contaminants
    - Levels of contaminants in Lake Ontario ecosystems have decreased significantly in the last 20-24 years.
    - Critical pollutant levels in fish tissue and herring gull eggs have also shown a significant reduction.
    - A new and emerging issue in the basin is the introduction of new chemicals such as Brominated Flame Retardants.
2. Introduction of non-native species
    - Benthos and nearshore phytoplankton populations are declining primarily due to zebra and quagga mussel introductions that disrupt the natural food web and displace native species.
3. Habitat Loss
    - New and emerging issues for habitat loss are increasing urban development and urban sprawl in addition to agricultural intensification.

Lake Erie/Detroit River – Lake St. Clair Ecosystem

The presentation provided by Dan O'Riordan, U.S. Environmental Protection Agency, focused on how central Lake Erie may once again be considered a "dead zone".

Lake Erie is considered the most biologically productive Great Lake, however its major stressors are urbanization and intensive farming. Currently, the biggest threats towards this ecosystem are:

1. Non-native Species
    - There are 34 non-native species in Lake Erie that compete directly with native species for food and habitat.
2. Changing Nutrient Dynamics
    - Although there have been significant reductions in loadings of nutrients, concentrations of phosphorus appear to be on the rise.
    - These increased phosphorous concentrations may be contributing to the oxygen-depleted zone in the central basin.
3. Land Use Alteration
    - The conversion of land surrounding Lake Erie due to increased urbanization and agriculture decreases the availability of good quality habitat for native species.

There are also on-going projects around the St. Clair River involved in non-point source pollution prevention to reduce some of the effects of changing nutrient dynamics in this ecosystem.

Lake Huron

Lake Huron was described as a relatively healthy ecosystem by Jim Bredin, Michigan Department of Environmental Quality, however future pressures on the ecosystem may cause a deviation from this trend.

Compared to the other Great Lakes, Lake Huron has relatively low pollution levels. Currently, it has an abundance of shoreline habitat, but this may change due to:

- Increased development pressure
- Hardening of the shoreline

In addition, Lake Huron still maintains a high diversity of aquatic and riparian species, yet these species remain threatened due to the increased introduction of non-native species. The physical integrity of the Lake Huron system is pressured due to:

- Resource extraction
- Water level variation
- Localized urban activity
- Construction of structural barriers such as dams that promote habitat fragmentation

Lake Huron Fisheries

Dave Reid, Ontario Ministry of Natural Resources, presented an overview of the current state of the Lake Huron fishery addressing some of the primary concerns for protecting the long-term vulnerability of this fishery.

The most significant change that occurred to this system was the introduction of non-native species including rainbow smelt, alewife and sea lamprey. Sea lamprey is deemed to be the biggest factor in changing the Great Lakes fish community. A decline in the lake trout fishery has turned around recently due to the control of sea lamprey and the stocking of non-native salmonies. The main fish community goal is to achieve a community similar to the historic system dominated by self-sustaining populations of lake trout as the top predator.

Lake Michigan

Bob Kavetsky, U.S. Fish and Wildlife Service, examined a status report on Lake Michigan and its current stressors, including the expected entry of the Asian Carp into the system.

The habitat in the Lake Michigan basin is under stress due to:

- Increased development
- Fragmentation
- Proportionately large wetland loss in the basin
- Toxic contaminants (resulting in a decline in commercial fishing harvest)

The Grey Wolf, a keystone species is recovering but *Diporeia* shows signs of distress in the Lake Michigan basin, and is possibly linked to the introduction of the non-native zebra mussels.

Lake Superior

John Marsden, Environment Canada, discussed how ecosystem pressures, such as the introductions of non-native species, may be threatening the status of this "healthy" Great Lake, even despite the number of community-based programs in place to protect this valuable system.

The stresses in this ecosystem, which may threaten the biological integrity of the system, are as follows:

1. Endangered Species
   - Fourteen species found in Lake Superior are listed nationally by Canada and the U.S. as either endangered, threatened or vulnerable.
   - An additional 400 species are listed by provincial or state agencies.
2. Non-native Species
   - Lake Superior has the highest percentage of non-native to native species. Non-native species represent approximately 20 % of the total species in the basin.
3. Habitat Fragmentation and Alteration
   - Changing landscape patterns in terrestrial systems needs to be incorporated into indicator objectives.
   - Pressures from forest cutting, associated road building, and increased residential development will continue to increase habitat fragmentation in the future unless it is dealt with carefully.
4. Chemical Contamination
   - Currently, the contaminant levels in waters and herring gull eggs in Lake Superior are decreasing.

Future concerns on all the lake systems in the Great Lakes basin include global warming and the continued introduction of non-native species to the system.

Lake Superior Fisheries

Ken Cullis, Ontario Ministry of the Environment, presented the state of Lake Superior fisheries.

- In 2002, lake habitat was in good condition, however the abundances of *Diporeia* are low compared to other Lakes.
- There is also a high percentage of non-native species present in the Lake Superior system.
- Lake trout represents approximately 80% of the sport fishery salmonid catch from Ontario waters.
- In terms of harvest, there is a dramatic trend towards a single fish species fishery, where currently Lake whitefish dominates.
- There is increased abundance of wild lake trout in Michigan, Wisconsin and Ontario waters of Lake Superior.
- Increased abundance of Lake Whitefish in most zones is a likely consequence of stocking after the collapse of Lake Trout fishery in the 1980s.
- An increase in sea lamprey populations, may stress the Lake Superior fishery.

5. SOLEC 2002 Break-out Session Summaries

Disclaimer – Comments expressed by SOLEC 2002 break-out session participants do not reflect the opinions of Environment Canada or the U.S. Environmental Protection Agency.

5.1 Management Challenges

The following Management Challenges were suggested and discussed at one or more of the break-out sessions on Day 1 of SOLEC 2002.

Habitat
- Identify, protect and / or rehabilitate critical habitats (spawning and nursery habitat; wetlands)
- Maintain adjacent upland areas near wetland habitats

Chemicals
- Improve management of chemicals
    - Reduce spills of pollutants
    - Further restrictions on in-use agricultural chemicals
    - Proper chemical disposal
    - Track down local sources of pollution
- Encourage voluntary pollution prevention
- Reduce acidic emissions even further

Non-native Species
- Prevent non-native species introductions from shipping, aquaculture, etc.
- Prevent range expansion of non-native species
- Establish refugia for native species (e.g. mussels)
- Legislation to protect native mussels
- Continue sea lamprey control

Monitoring and Research
- Develop / enhance monitoring programs, including tributaries
- Standardize measurement units and assessment methods
- Research on ecosystem components such as *Diporeia* population decline; early mortality syndrome in lake trout; phytoplankton population dynamics
- Develop methods for quicker assessment of water quality at beaches
- Expand the database of drinking water plants surveyed and establish a common data base accessible to all drinking water suppliers
- Source water protection - reduction of CSOs and non-point source runoff
- Refinement of the sediment quality index
- Monitor impacts of water level fluctuations on nearshore terrestrial communities

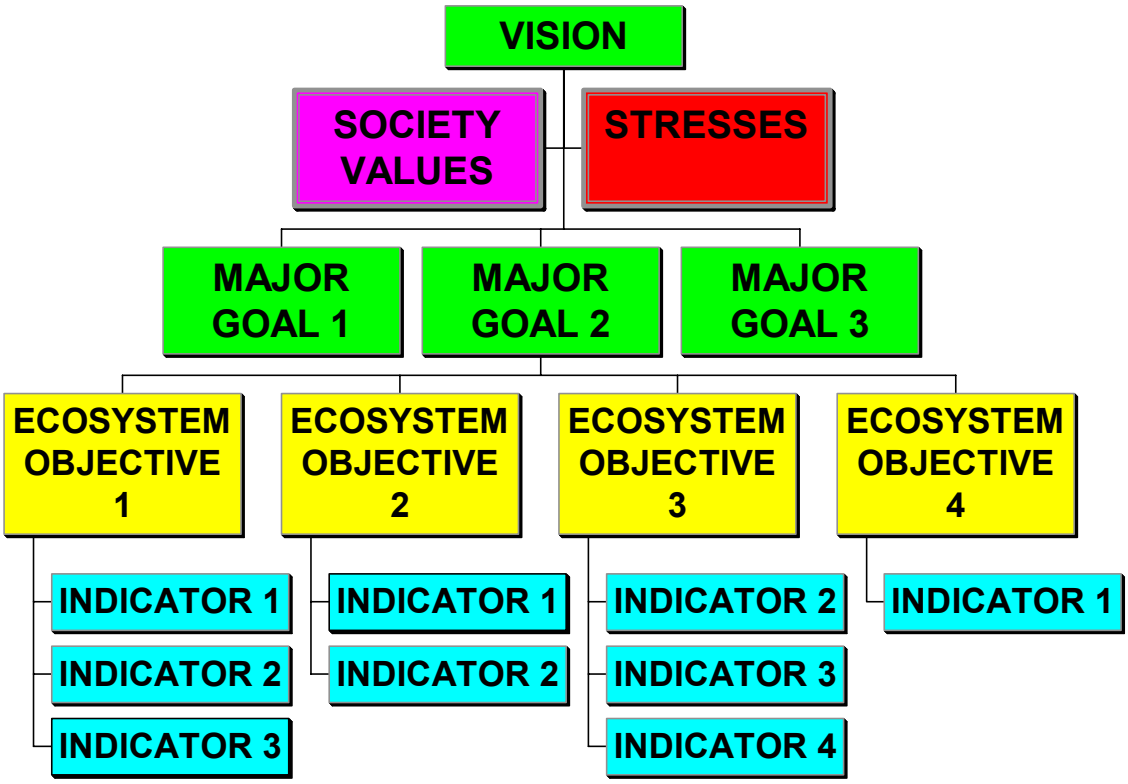
Management/Planning
- Comprehensive land use planning including “green” features such as in-filling and brownfield redevelopment
- Promotion of cost effective public transit including development of a database for all transit authorities
- Plan for growth of human population (e.g. assess Sewage Treatment Plant capacity to deal with increased load)
- Water conservation (water meters for example)
- Need for renewable energy supplies (wind, solar)
- Public education (habitat, endangered species, non-native species, etc.)

5.2. Introduction to Indicators Break-out Session

Intro to Indicators Session
Facilitator: Paul Bertram - Great Lakes National Program Office, U.S. Environmental Protection Agency
Recorder: Jessica Gibney

This presentation was prepared for SOLEC 2002, and was intended to provide a brief overview the Great Lakes indicators, and how this suite of indicators was derived.

- The following figure is used to visually depict indicator development:



- It is important to understand the relationship between VISION, GOALS, ECOSYSTEM OBJECTIVES and INDICATORS:
    - A VISION is the "big picture" or the overall goal for the Great Lakes. For example, the overall vision for the Great Lakes taken directly from the Great Lakes Water Quality Agreement (GLWQA) is "…to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin ecosystem".
    - Once we have the overall VISION, we can then set up major GOALS for various parts of the VISION. GOALS are influenced by both societal values and by the stresses that are currently being imposed on the ecosystem, and are entities that we might be able to measure and achieve.

        - Societal values tend to dictate the uses to which we use or restore the Great Lakes (i.e. we could manage them for maximum sustained harvest of fish for food, or we could manage them for human health implications). Often times these uses are not mutually compatible.
        - In addition, there are many stresses currently imposed on the ecosystem: like too many nutrients, toxic contaminants, habitat alteration, and invasions of non-native species.
        - An example of a GOAL, or general objective from the GLWQA is that "These waters should be: Free from nutrients…in amounts that create growths of aquatic life that interfere with beneficial uses".
    - Once we have identified our major GOALS, we can then establish specific measurable OBJECTIVES. The concept is if we achieve all the specific OBJECTIVES for any given goal, we will reach that major GOAL.
        - An example from a specific, quantified OBJECTIVE from the GLWQA is an established recommended maximum annual phosphorous loadings for each of the Great Lakes; for Lake Erie the annual loading objective is not more than 11,000 metric tonnes.
    - Then once we have the quantified objectives established, we need to measure progress towards them. INDICATORS are measurable parts of the ecosystem from which we can infer information in relation to the objectives. There can be several INDICATORS related to the same objective.
        - For example, if the GLWQA sets phosphorus loading OBJECTIVES for the Great Lakes, specifically 11,000 metric tonnes for Lake Erie, we can measure phosphorus concentrations in the water as an indicator of achievement of the objective. And the relationship between phosphorus in the water and plankton growth allows phosphorus concentrations to be used as an indicator of trophic status of the water.
    - There is also another aspect to indicators that we need to be aware of: we need both a MEASURED value and an expected TARGET or ENDPOINT. We can then compare the observed measurement against the desired state to allow us to make an assessment based on the indicator.
        - The MEASUREMENT- what is the *observed* state of the ecosystem component being measured?
        - The REFERENCE value – what is the *desired* state of the ecosystem component being measured?
    - It is important to note that not all indicators are created alike; some are more effective than others. Thus, for SOLEC we use a set of criteria to apply to candidate indicators; the overall criteria are those of NECESSARY, SUFFICIENT and FEASIBLE. Is each indicator needed, or is there some redundancy in the set? Are all the indicators, taken as a whole, SUFFICIENT to characterize the Great Lakes ecosystem components, or are some elements missing? And is the indicator FEASIBLE to measure and report?
- The process for identifying the Great Lakes indicator list looks very simple on paper, but it required approximately 2 years of work that involved at least 150 people.
- A core group and expert panel were created for each of the geographic areas and non-geographic issues.
- Each of the groups mined indicators and indicator ideas from the existing sources.
- The groups then screened their long lists and revised, combined or created new indicators as needed.
- The work of all the groups was combined into the proposed Great Lakes indicator list and presented at SOLEC 1998.
- We are now working on the 5th version of the indicator list; each version has gone through a cycle of stakeholder review and core group revisions.

- The take-home message about the SOLEC process for selecting Great Lakes indicators is that it is an open process that involves many, many stakeholders. We are continually reviewing the indicators, the details of the indicators, and making improvements and revisions. This is a continual cycle of review, revise, review, and revise. In doing so, we are trying to build consensus on the indicators, and to foster collaboration and cooperation among Great Lakes stakeholders.
- For SOLEC 2002, we are considering the addition of indicators for parts of the Great Lakes ecosystem that have not been assessed before: including groundwater, forestry, societal response, agriculture and others.
- The Great Lakes indicator suite can be categorized using the following categories of State, Pressure, and Activities (Response).

5.3 Break-out Sessions on Indicator Assessments – Day 1

Human Health
Facilitator: Lois Corbett – LURA Consulting
Recorder: Jessica Gibney

About the Indicator and Assessment

- In general, the assessments are good, though more work could be done in communicating the results to a wider audience. Additionally, there are special information needs of sensitive populations and the public health officials who work with them including women, seniors and children.
- More work needs to be done to align data collection methods across all jurisdictions.
- Need to target multiple audiences but be good at meeting the needs of the general public. They need to know: "Can I take the kids for a swim today? Should I eat the fish, or what is my PCB load?"
- Enhancements or refinements:
    - Consider including fish species other than the Coho salmon.
    - Experiment with a wider range of graphical representations of the data.
    - Consider human health indicators of good health, or healthy communities and families – too much emphasis on "death and dying" indicators.
    - Consider putting beach closures into more context – provide usage data, for example.
    - Move away from counting beach closures solely and towards reporting on water quality.
    - Exploit the communication opportunity of human health indicators as decision-makers really use/need this information.

Key Linkages with Other Indicator Categories

- We need to resist merely choosing indicators with obvious linkages to the human health problems. An interesting exercise would be to look at the entire suite of indicators through a human health lens – the benefits may include clearer communication.
- We need to look at all the links in the chain: SOE reporting, to human health indicators, to behaviour change to protect health, to behaviour change to prevent pollution, and back again.

Management Challenges and Implications

- The challenges are of *consistency* – how do we ensure that we track the same information in the same way; of *continuity* – how to ensure we continue to support our monitoring programs; and of *trajectory* how do we follow the result of an indicator through strategically, knowing exactly when that issue is going to move.
- How do we build budget campaigns and a real understanding of financial implications of the indicator work?

Open and Nearshore Waters
Facilitator: Gary Kohlhepp – Michigan Department of Environmental Quality
Recorder: Alicia Endres

About the Indicator and Assessment

- There is a need to better define the targets and endpoints for many indicators, so we can better document successes.
- Need better definition/clarity on the "further work" and "future activities" sections of the indicator write-ups; sometimes, the "purpose/objective" sections are not fully addressed.

- More data is needed for certain indicators, i.e. Habitat/Walleye.
- Distinction needs made between nearshore and open water. Definitions should be made on a lake-by-lake basis.
- End points or goals are needed in the progress reports (if applicable).

Key Linkages with Other Indicator Categories

- There are many good linkages between state and pressure indicators; however, there are no societal/human activity/management indicators for open and nearshore waters – such indicators should be identified and developed.

Comments on Specific Indicators

- Fish Habitat
    - No assessment was completed for this indicator as a broad indicator needs to be broken up into smaller, more precise indicators.
- Salmon and Trout
    - The write up did not address the objective; it is hard to evaluate this indicator in the absence of data.
- Walleye
    - Predators are a good indicator.
    - They need to be weighed differently according to separate lakes.
    - Differential fish stocking may lead to flawed census data.
    - Consider the effects of harvest versus natural population changes.
    - Take into account that historical targets may no longer be attainable.
    - We should make use of population models and estimates that are not based entirely on fishery data/commercial harvest rates.
- *Hexagenia*
    - This write-up received praise from the group.
    - The monitored area should be extended.
    - An endpoint for this indicator needs to be established.
    - This Indicator provides a good historical database for comparison.
    - However, it should be noted in the indicator report that oxygen is the stressor.
- Contaminants (Water birds)
    - This indicator seems to be carefully carried out.
    - Quoted to be the most “quantitative and sophisticated indicator” used.
    - This good indicator rating is based on its clear endpoint.
    - The coverage area encompasses the entire Great Lakes basin.
    - The reference point used in this indicator is questionable.
- Zooplankton
    - When using “mean length” no ranges or peaks are included.
        - This data is affected by net size, non-native predator bias, and genetic influence.
- Contamination (Sediments)
    - Need to identify how the index is calculated.
    - Need data for all the lakes.
    - Need to specify the depth.
- Atmospheric Deposition
    - This indicator seems to have no quantitative goal.
    - The objective of this indicator needs refinement.
    - Zero loading may still be problematic.
    - There needs to be a separation of the data by chemicals.
- Abundances of *Diporeia*
    - This indicator is most appropriate for deeper waters.
    - The weather can have an effect on the timing of subsequent data.

- Deformities, Eroded Fins, Lesions and Tumours (DELT) in Nearshore Fish
    - Should be replaced with External Anomaly Prevalence Index (EAPI) for Nearshore Fish (Indicator #101R).
- Benthos Diversity
    - This is not well defined.
    - It is hard to collect data for this indicator.
    - Contamination is present.
    - Gives a bias sample making historical data irrelevant.
    - This indicator should be more encompassing.
- Phytoplankton Populations
    - Identified as a faulty indicator.
    - Need to identify endpoint criteria.
    - Relate to diatom/sediment indicators.
    - This indicator tends to hide emerging problems.
    - Need to acquire uniform sampling procedures.
    - Should use a ratio of edible: inedible or a possible ratio of blues:greens.
- Preyfish Populations
    - Some preyfish are non-native.
    - Mostly Pelagic.
- Lake Trout
    - Needs to incorporate a focus on perch (whitefish-native fish, not stocked).
        - Could be influenced by climatic conditions (could be good or bad).
    - If we examined the balance of predators/fish it would be an encompassing indicator.
    - Need concrete species in study: thus we should focus on important species.
- Phosphorus Concentrations and Loadings
    - Need more tributary loading information:
        - Should monitor tributaries.
        - Get intrinsic concentration and good flow information.
    - We should have separate indicators for loading.
    - Maybe the indicator should be ranked “good” for all 4 lakes except for Erie.
- Contaminants in Whole Fish
    - Essential part of determining status.
    - Need chemical monitoring.
    - Do not need to measure Coho salmon for trend analysis, as it is too variable.

Coastal Wetlands
Facilitator: Joanna Kidd – LURA Consulting
Recorder: Clarence Lam

About the Indicators and Assessment

- Important work is being done both within and outside the SOLEC process.
- Current indicator suites and assessments represent good progress, but do not yet provide a clear, complete picture.
- A key gap is in wetland extent (area), although the Great Lakes Wetlands Consortium is now developing this.
    - There is currently no complete inventory for the Great Lakes.
- Change in Wetland Area is an important indicator for SOLEC:
    - The current estimates of wetland area lack precision and requires repeated collection and analysis of remotely sensed information.
    - The Great Lakes Wetland Consortium is working on finalizing a project to classify the inventory and fill in the gaps.

    - They need to assess technologies and methods for estimating wetland area; they need to determine funding and resources needs; and finally they will need to pilot test those selected methods to determine if they will be effective on a Great Lakes scale.
- Contaminants in turtle eggs appear to be a good indicator of the health of coastal wetlands – need to correlate this with water and sediment quality.
- Snapping turtles are good indicators for a variety of reasons:
    - They inhabit and nest in the lower Great Lakes basin.
    - They are long-lived and are common year-round.
    - They live in many habitats, but also have fairly limited movements between wetlands.
    - Research has found a correlation between eggs and maternal burdens regardless of contamination levels.

Key Linkages with Other Indicator Categories

- Land use; shoreline hardening.

Management Challenges and Implications

- Work is being slowed by a lack of funding – a more complete assessment could be conducted in the next few years with proper funding.
- There is still a need for more coordination and collaboration, particularly for data sharing, across jurisdictions.
- Regarding implementation of the monitoring plan: should position the "package" as a business plan (i.e. to attract clients and funders); should include conservation authorities and citizen-cantered monitoring groups; consider training programs for those collecting data; need continued work on data standardization, data sharing protocols and sampling design; need to consider how best to communicate results; consider linking the wetlands work to a broader Great Lakes restoration strategy; and *it is a priority* to finish the implementation plan before funding runs out.

Land and Land Use
Facilitator: Pam Hubbard – Pam Hubbard and Associates
Recorder: Carrie Hornbeck

About the Indicators and Assessment

- There is a general concern that the current set of three land use indicators is not sufficient and too simplistic to provide an accurate picture.
- Impervious surface is a key gap in the indicator suite and should be added; it provides a more complete picture of land consumption than urban density.
- Need to add a more direct measurement of automobile use to the transportation indicators.
- Need to ensure that there are measures and endpoints for the indicators in order to ensure that the assessments are meaningful.
- Nearshore terrestrial indicators need to be monitored on a watershed basis; some appear to be duplicative of other biological indicators.

Key Linkages with Other Indicator Categories

- Land use relates closely to every other indicator category (i.e. urban density and mass transportation), except open waters. In addition there appears to be a gap between the socio-economic and biophysical indicators.

Management Challenges and Implications

- Funding is needed to collect, compile, analyze and standardize the data.
- SOLEC needs to forge better links for land use data collection with municipalities, metropolitan areas and planning commissions.
- Decision-making on land use is local but implementation is on a regional scale; i.e. there is often a discrepancy between where land use decisions are made and where impacts must be addressed.
- Need better ways to communicate to politicians at all levels, land managers and transportation users.
- Need a better understanding of incentives and disincentives.

Comments on Specific Indicators

- Land Use
    - Need to reflect the impact of impervious ground cover, as urban density is not enough. The change in impervious surface reflects the environment more.
    - Households would be a better measure than population.
    - Need total populations, not just urban; thus the indicator should include suburban, rural and urban populations.
    - The ratio of urban to agricultural to natural land use would also be beneficial, in order to see how they change within a certain study area.
    - Need a land use efficiency calculator to develop a balance that includes many measures; and will then be better able to show the impact on the future.
- Mass Transportation
    - Time frame is too short.
    - Data needs to be normalized to population growth.
    - Mass transportation is not a surrogate for transportation changes.
    - Some feel it should be eliminated as an indicator; instead we should have a direct measure of private car use, fuel use per capita, land devoted to cars or lengths of commutes.
    - We could also look at the amount of funding spent on infrastructure (roads/bridges) verses money spent on mass transportation.
- Sustainable Agricultural Practices
    - Tillage transect data is a more precise indicator with on-the-ground phosphorus and nitrogen indicators.
    - It was suggested that this indicator should be moved to societal response.
    - Need to set up monitoring stations: target watershed, monitor nutrients, pesticides, pathogens, sediment, etc.
    - When federal funding becomes involved then implementation of this indicator will be there.
    - An additional indicator could be added for the encroachment of land use onto wetlands.
- Great Lakes Islands
    - Assessments did not give any measurements for the indicator.
    - Suggested measurements: area of islands at a specific water level, number of islands, percent increase in protection status, identify island habitats, threatened rare and endemic species and monitor population size.
- Extent of Hardened Shoreline
    - Need to assess rivers beyond the mouth.
    - May require greater spatial data.

Unbounded/Under Development
Facilitator: Vicki Thomas – Great Lakes National Program Office – U.S. Environmental Protection Agency
Recorder: Lisa Leighty

About the Indicator and Assessment
- Need a clear explanation of how the indicators are being used.
- "Unbounded" topics could fit largely under a "climate change" category.
- Suggested additions: precipitation, CO_2 levels.
- The value of the ice duration indicator is unclear.

Key Linkages with Other Indicator Categories
- Land use; species diversity.

Management Challenges and Implications
- SOLEC needs to consider adaptation strategies and consider both warming and cooling climate change scenarios.

Comments on Specific Indicators
- Ice Duration
    - Ice duration is an indicator of climate change. We must look at trends and variability, timing of formation and the time of ice break-up is also important.
    - Another area of interest includes: trends in water level, as it can also be a useful indicator of climate change.
    - One participant suggested that we should not be so interested in climate change because we cannot change it. Instead we should be interested the ecosystem impacts; for example, the impact of ice cover on living species in the lakes.
    - Many participants were unsure as to why we were interested in looking at ice duration.
    - The range of variability of ice cover needs to be examined more closely in order to compare to the past.
- Extreme Storms
    - There is a total absence of precipitation indicators in the Great Lakes suite; no rainfall, snow cover, or drought data. Thus, we may want to look at the extremeness of an event (i.e. 4 inches of rain in a month versus 4 inches of rain in a day).
- Acid Rain
    - Are there smaller lakes in the Great Lakes basin affected by acid rain? How does acid rain affect the watershed?
    - Is acid rain still as highly tracked now as it was 10 years ago?
    - Acid rain is a good indicator for the Great Lakes basin, but what about the individual lakes?
    - Should acid rain be a Great Lakes indicator at all? There are specific programs that monitor acid rain. Maybe we should not spend time and energy on topics other programs are dealing with.
    - The acid rain indicator would be more helpful if it focused on its effects on fish spawning, or health of plant populations.
- Non-native Species
    - The graph in the indicator report is not clear (p.126 of Implementing Indictors). Is it just depicting that we have two more non-native species this year than last?
    - However, not all non-native species have an equal impact on the ecosystem. How will these different impacts be reported?
    - We need to know how the problematic species will be reported differently than the non-problematic ones.

    - Is there some type of monitoring system outside the Great Lakes basin to let us know if non-native species are approaching?
    - We need to identify entryways into the Great Lakes besides the St. Lawrence River.
- General Comments and Observations
    - We need a better title than "unbounded."
    - Many of the indicators under this section are related to climate change.
    - SOLEC needs to be considering adaptation strategies, consider climate change scenarios (for both warming and cooling).
    - Also, what efforts are being made to sort through the indicators and assess which indicators should be continued and which should be removed?

5.4 Break-out Sessions on New Indicators – Day 2

Biological Integrity
Organizer: Doug Dodge – Stream Benders
Facilitator: Dave Dilks – LURA Consulting
Recorder: Lisa Leighty

About the Proposed Suite of Indicators

- Need to incorporate a watershed approach in the suite, including indicators that address "great rivers", connecting channels and tributaries.
- Need to move towards multiple community and biological indices that permit an integrated assessment.
- Once the initial suite has been implemented, it will be important to assess its performance to see if it is telling us what we need to know.
- Suggested additions to the Biological Integrity (BI) suite include:
    - For Open and Nearshore Waters – microbial health, mysis, sediment contamination;
    - For Coastal Wetlands – invertebrate community health, fish community health, amphibian community health (the Great Lakes Wetlands Consortium is now collecting information on these indicators).
- Several of the proposed coastal wetlands indicators were said to impact wetlands, but are not good indicators of BI. It was suggested these indicators be kept, but moved to other categories.
- More work is needed to develop nearshore BI indicators – only 3 on the current list addresses this area. Lack of scientific information (e.g. young-of-year) is a key information gap.

Comments on Specific Indicators

- Open Waters
    - Are we investigating enough species?
    - Should we be looking at non-native species as true indicators of ecosystem health (i.e. Salmon and trout), particularly because they are stocked (artificially enhanced)?
    - Perhaps a better indicator would be to look at the percentage of success in spawning areas.
    - We need to go with the watershed approach to really understand this topic, thus we need to develop a community structure or biological index that explains all the factors involved.
    - Walleye – different strains spawn in different spots, which then create different life history strategies. Thus, we may want to consider these differences in our reporting. Thus, walleye production to adult stage is dependent on natural conditions, so life histories of the species are helpful; but harvesting information is not.
    - *Diporeia* – the *Diporeia* situation is not well understood; populations are declining however we do not know why.

- Preyfish Populations – They are mostly non-native, so what do these species really indicate?
- Fish Habitat – how much is enough? We need to see what the relationship is between fish habitat and fish out in the lake.
- The Non-native Salmon and Walleye indicators were regarded as "unimportant" as they are already heavily managed.

- Nearshore Waters
  - It was suggested that we divide open and nearshore waters into two categories. Very few of the indicators are appropriate for nearshore waters, this could be due to the lack of information we have regarding these zones; sampling and data collection is difficult.
  - Nearshore areas are zones of high diversity and should be treated with high concern.
  - These areas are extremely important, but there is a fundamental lack of good nearshore scientific information.
  - Current indicators for understanding status trends are very poor at this time.
  - Some helpful indicators include:
    - *Hexagenia*
    - Benthos Diversity and Abundance
    - Non-native Species
    - Native Unionid Mussels
    - Phosphorus Concentration and Loadings
    - Contaminants in Young-of-the-Year (Y-O-Y) Spottail Shiners
    - Sediment Available for Coastal Nourishment
  - We need to address species that are indicators of shore regions (i.e. species typically found in nearshore regions, midshore and offshore).
  - Contaminants Affecting Productivity of Bald Eagle and Contaminants in Nesting Bird areas indicators should be moved to the nearshore category from coastal wetlands.
  - The Contaminants Affecting the American Otter indicator should be moved into the coastal wetlands category instead of nearshore waters.
- Coastal Wetlands
  - Four years ago, the EPA put out a call for experts on wetland indicators to implement a coastal wetlands monitoring system; however the coastal wetland indicators have not been modified yet.
  - Contaminants in Snapping Turtle Eggs has been decided that is it is an effective indicator for looking at coastal wetlands.
  - The Presence, Abundance and Expansion of Non-native Plants indicator should be expanded to plant health and integrity.
  - Wetland-Dependent Bird Diversity and Abundance indicator is "fine-as-is".
  - The Great Lakes Commission is gathering information on wetlands from various sources in order to assign classification, to report on the Coastal Wetland Area by Type indicator.
  - It was suggested that the following indicators be removed from the Coastal Wetlands subset, however should still remain in the Great Lakes suite of indicators as they are all physical or chemical indicators and are not indicators of biological integrity:
    - Coastal Wetlands Area by Type
    - Sediment Flowing into Coastal Wetlands
    - Water Level Fluctuations
    - Contaminants in Colonial Nesting Birds
    - Contaminants Affecting the Productivity of Bald Eagles
    - Habitat Adjacent to Coastal Wetlands
  - It was suggested that the following indicators be added to the Coastal Wetlands suite:

        - Invertebrate Community Health and Integrity
        - Fish Community Health and Integrity
        - Amphibian Diversity and Integrity
- Terrestrial and Unbounded
    - It was mentioned that the land use and ecosystem health indicators are very broad scale, and act more as pressure indicators rather than state of the ecosystem indicators.
    - It was also suggested that a subset of indicators for tributaries is needed; we need to look at these areas if we are truly interested in the health of the basin.
    - We also need to consider the amount of wetlands we have restored in the basin; we need to know both what we have lost and what we have inadvertently gained.
    - Landscape ecosystem health looks at the system itself; it looks at the amount of natural cover in landscape, distribution of cover in the watershed and basin, ratio of urban to habitat size, average habitat size and shape.
    - The problem with these indicators is the idea of BASELINES:
        - We need to know what levels of habitat coverage we should be at. And these baselines should at least be based on levels prior to settlement of the area.
        - It was also stated that setting the baseline at pre-settlement coverage is not practical, especially in the lower lake areas.

Next Steps

- Sufficient data is available to begin "populating" many of the BI indicators.
- Models or "test cases" can be developed on a pilot scale, prior to broader implementation.
- The key is to start now using the best data available (e.g. harvest data), while identifying future data needs.
- Further opportunities for basin wide collaboration on implementing the BI suite need to be identified.
- Good work is now being done – the idea should be to build on and link these efforts where appropriate.

Groundwater
Organizer: Doug Alley – International Joint Commission
Facilitator: Joanna Kidd – LURA Consulting
Recorder: Ashleigh Hanson

About the Proposed Indicators

Physical/Chemical Indicators

- There was general support for the five proposed physical/chemical indicators for groundwater (i.e. they met the criteria of necessary, sufficient, and feasible).
- Endpoints need to be set for each indicator.
- Data gathering and compatibility need to be addressed.
- Need to look carefully at base flow – consider the changes over time in base flow and possibly relate these changes to climate change.

Biological Indicators

- There was a general support for the use of a biological indicator.
- Focus efforts on plant and animal communities that depend on groundwater rather than on a single species.
- It may make sense to look separately at headwater communities and stream communities.
- Ohio can help other states and provinces with setting baselines for biological indicators.
- A consortium should be convened to further develop biological indicators for groundwater.

Comments on Specific Indicators

Physical/Chemical Indicators

1. Base Flow to Groundwater Discharge
    - Base flow is the more slowly variant component of stream flow and is attributed to groundwater distribution to wetlands, lakes, and rivers.
    - It is often masked by flow retention, flow regulation, and wastewater distribution.
    - There are various anthropogenic (human) factors that impact base flow in the sub-watershed including: deforestation, forestation, and paved hard surfaces that do not absorb groundwater.
    - Proposed that base flow statistics can detect patterns.
    - Use stream flow information to measure groundwater indicators.
    - Human uses such as dams mask accurate figures of water flow in some areas.
2. Land Use and Intensity
    - This indicator measures primary use of land (% for livestock feed lots) and intensity of use (number of cattle/hectare).
    - The impacts of prevailing patterns of land use and intensity are not certain.
    - Land use may influence water use and intensity and may be functions of physiographic factors.
    - Land use may also be used to infer potential impact of human factors on quality and quantity of water.
3. Groundwater Use
    - This indicator measures water use within political subdivisions, but must pool data concerning the use of water from each state or province on some common system that currently does not exist.
    - Infer potential impacts of use and intensity on quality and quantity of groundwater.
    - Measures supply versus demand by assessing the construction of new wells and the deepening of existing wells.
    - Most groundwater use is in the interior parts of the land. Need to consider use of groundwater for bottling companies that are taking water from farmers. How does the removal of groundwater effect drought conditions?
    - This indicator also needs to consider withdrawal of water versus consumptive use of water; however, there are not concrete standards (i.e. Milwaukee counts withdrawal of water from aquifers as consumptive use, while other states do not).
4. Natural and Human Induced Groundwater Quality
    - Assess quality of groundwater for drinking purposes and agriculture and ecosystem functions.
    - Identify areas of contamination, programs for remediation, and prevention of non-point contamination.
5. Groundwater Management
    - Effective management and protection of groundwater resources is dependent on technical data, planning and policy for decision-making.

Biological Indicators

1. Groundwater and Amphibian Communities
2. Groundwater Dependant Animal and Plant Communities
    - Brook Trout
        - Life cycle is completely related to groundwater, and thus can be used as an indicator of conditions.
        - Springs are their spawning/nursery habitats.
        - Groundwater perturbations and reduced flow rates results in decline in brook trout abundance; thus there is a direct correlation between abundance and groundwater flows.
        - The only problem with brook trout is that they are not present in all systems.

- Salamanders
  - Salamanders are adapted or have migrated away from ecosystems, containing fish, as they are the salamanders' biggest predator.
  - They represent a good indicator for groundwater quality because they require constant flowing cool water to survive.

3. Managing Groundwater Resources

Development of Indicators

- Only include indicators where cause and effect relationships are known, thresholds can be set, and qualitative measurements can be made; and focus on measuring changes (e.g. in base flow, water use, brook trout presence, etc).

Other Key Comments

- Groundwater needs to be linked to surface water.
- We need to understand and set a target for the amount of base flow in rivers that is needed to sustain ecological processes.
- Indicators need to be tied to the physical landscape.

Societal Response
Organizer: Laurie Payne – LURA Consulting
Facilitator: Laurie Payne – LURA Consulting
Recorder: Jessica Gibney

About the Societal Indicators

- The main conclusion from this session is that the societal indicator suite (adopted and proposed) needs substantial re-evaluation and re-organization.
- The structure or framework of the societal indicators, including land-use indicators, also needs substantial re-evaluation and reorganization.
- Need stronger linkages between the indicators and the objectives.

About the Societal Response Indicators

- Again, the purpose of the societal response indicator subset requires a better definition. The question still to be answered is, "What should we be measuring?"
  - Attitudes toward protecting Great Lakes ecosystem health?
  - Societal Action?
  - The effect of societal action on the integrity of the system?
  - All of the above?
- Issues addressed by the societal response indicators are generally on the right track, but the measures are not necessary, sufficient, or feasible.
- Need better correlation between the indicator and the state of Great Lakes ecosystem.

Comments on Specific Indicators

- Household/Community Indicator Group
  - Household Stormwater Recycling – at best the indicator is insufficient, and perhaps unnecessary.
  - Community engagement in Great Lakes Protection and Decision-Making – reasonable indicator, but there are both attitudes leading to practices, and leading to ecosystem effects, and you cannot track just one of them.
- Commercial/Industrial Indicators

    - Commercial/Industrial Environmental Management Systems (EMS) - just tracking the number of EMSs does not seem useful unless there is a linkage between Great Lakes management and EMS.
    - Commercial/Industrial Participation in Eco-efficiency Programs – this is a stronger indicator than tracking EMSs, this indicator included the elements of an EMS.
- Cross-Cutting Indicators
    - Vehicle Use – this is a necessary indicator and the best measure would be fuel consumption.
    - Economic Prosperity – the session did not feel that employment was a good indicator of the state of the lakes ecosystem.
    - Aesthetics – the session thought that this indicator is probably unnecessary, unclear and problematic to measure.
- Institutional/Educational Indicators
    - Financial Resources Allocated to Great Lakes Programs – some of the participants felt that just having the financial resources might not indicate the effectiveness of these dollars.
    - Environmental Education – It was not obvious to the participants how education translates into environmental responsibility and recommended focusing on action instead of awareness. Suggestions were also made to look at informal education.
    - Municipal Wastewater Treatment – Need an indicator of wastewater. This indicator should include a measure of combined sewer overflows. It was felt from the session that treatment does not necessarily imply compliance, though compliance was also found to be difficult to measure.
    - Taxes on Energy/ CO_2 – this indicator needs to be completely changed, should focus more on population growth and performance bases.
    - Municipal Cosmetic Pesticide Control – Bans do not equate actual reductions. There are better measures of societal response. More explanation of this indicator is needed (undefined premise, vague). Not a necessary indicator.

Forestry
Organizer: Bill Meades – Great Lakes Forestry Center, Natural Resources Canada – Canadian Forestry Service
Facilitator: Gary Kohlhepp – Michigan Department of Environmental Quality
Recorder: Carrie Hornbeck

About the Proposed Indicators

- The proposed indicators are good, but definitions need to be fleshed out (e.g. define the difference between sustainable forest management and ecosystem health and what is fragmentation, etc).
- Potential additional indicators:
    - Impact of air quality on forest health.
    - Forest diseases also need to be addressed in some form.
    - The session suggested that SOLEC might also want to include an indicator relating forestry to climate change.
- Need to consider changes in forest scale – local, regional, basin wide, national, etc when considering forestry indicators.
- It should be kept in mind that this forestry suite of indicators is geared towards the Great Lakes.
- Further refinement of the forestry indicators is desirable, with input from groups with forestry expertise and management responsibilities.

Comments on Specific Indicators

1. Sustainable Forest Management
    - How easily can this indicator be measured?
    - Measure the number of forests enrolled in the certification process, e.g. measuring how much forest is public versus privately owned.
2. Public Participation in Forestry Decisions
    - How do you get the public involved?
    - Not a fair measurement, as it is an interpretation of the public.
    - Deemed to be not an indicator of forest health but of sustainability.
    - Does this indicator fit into the Great Lakes indicator suite?
    - What is the endpoint? And how do you define it?
3. Forest Based Employment Picture by Sector
    - This indicator is important for planning.
    - Data is currently available.
    - This indicator needs to get consistency in jurisdictions and basin wide.
4. Forest Usage
    - This indicator shows that with certain management practices in place, forestry usage can be maintained.
    - It is good to recognize the change of uses over time and acceptability of those uses.
    - Also should consider management plans on public and corporate land.
5. Forest Land Ownership and Utilization
    - Ownership is very important.
    - This indicator is not only looking at the value of a fallen tree, but also at the value of a standing tree; and thus it shows the range of uses.
6. Non-native Forest Species
    - The indicator needs to look at insects and diseases as well as plants.
    - This indicator should measure acres impacted or infested.
7. Best Management Practices for Water Quality
    - The session found this indicator difficult to measure.
    - Compliance is an indirect measure – you can have good compliance and still have bad water quality.
    - This indicator may not be a direct measure of forest health.
    - This indicator is important to the Great Lakes suite of indicators.
8. Forest Fragmentation
    - This indicator requires a clearer definition.
    - Land use may not a forestry issue.
    - For this indicator to be effective we must have a working definition of fragmentation.
9. Forest Land Base
    - This is a good indicator to keep in the Great Lakes suite.
    - Need to keep track of the forest state – losing, gaining, and planting versus rates of harvesting.
    - This indicator could take a lot of time to measure; however, a plot network is already in place.
10. Featured Species
    - An umbrella species is needed to indicate a broad state of forest.
    - Key species can act as a surrogate for forest health.
    - The problem is in defining the habitat, which may result from a gap between science, management, and the people.
11. Forest Species at Risk
    - This indicator would include forest-based species which are generally non-tree dwelling.
    - The participants felt this was a good indicator.
12. Area of Forest Cover Types
    - Participants felt that this indicator should remain in the Great Lakes indicator suite.

Next Steps

- Many other forestry groups now collect data that would apply to these proposed indicators – these connections need to be established.
- The break-out groups identified data sources and contacts.

New Agricultural Indicators

Organizers: Peter Roberts – Ontario Ministry of Agriculture and Rural Affairs
Roger Nanney – United States Department of Agriculture
Facilitator: Jim Bredin – Office of the Great Lakes, Michigan Department of Environmental Quality
Recorder: Clara Adeglate

About the Proposed Indicators

- Three indicators (including two new indicators) were developed to address some of the major agricultural concerns such as pesticides and erosion:
    - Sustainable Agriculture
    - Nutrient Management Plan
    - Integrated Pest Management Plan
- There is a need to ensure that nutrient management plans are being implemented. From this break-out session there is a general concern that the proposed indicators will not yield enough information about whether desired practices are actually being implemented effectively.
- Links need to be made with biophysical indicators (e.g. water quality parameters).
- A conservation tillage indicator was suggested as an addition to the proposed agricultural subset.
- Key data sources include: Pesticide surveys done every 5 years (NRCS database); reports by Agriculture and Agri-Food Canada on the Agri-environment indicator project.

Comments About Individual Indicators

1. Sustainable Agriculture
    - In Canada, a three-phased environmental farmer plan has been developed.
        - They have over 14,000 plans in development with an application of over 300 acres.
    - In the U.S., they have over 13 major conservation plan indicators.
        - Including: nutrient management, erosion control, tillage and residue management, etc.
2. Nutrient Management Plan
    - In Canada there are two time frames:
        - Prior to June 2002, there was the development of bylaws.
        - And from June 2002 to present, there is the development of the nutrient management act; this is a good indication that Canadians are moving in the right direction.
    - In the U.S., there are two programs dealing with Agricultural Nutrients:
        - Environmental Quality Incentive Program (EQIP).
        - Comprehensive National Management Plans (CNMP) developed by the U.S. Department of Agriculture.
3. Pest Management Plan
    - Every farmer has different pest issues and different plans.
    - In Canada, anyone using pesticides must be certified; and approximately 40% have registered for certification.
    - In the U.S., each county has an organization, which is a locally based group, which is in charge of natural resources.

Next Steps

- Need to bring social scientists into the discussion of human response indicators.
- Need to consult with farmers about whether the indicators will be meaningful for them.

Developing Indices

Organizers: Wayne Bond and Risa Smith – National Indicators and Assessment Office, Environment Canada
Facilitator: Lois Corbett – LURA Consulting
Recorder: Sapna Batheja

General Discussion on the Proposed Canadian Biodiveristy Index

- The reason for the proposed Canadian Biodiversity index is to communicate, in non-technical terms, to the people of Canada of the importance of biodiversity.
- The index would serve as a tool that provides a consistent methodology for assessing and evaluating the health of ecosystems; it is necessary for the index to have a specific set of indicators.
- The index can be broken down into habitat types; for example, it can be separated into grasslands, wetlands and old growth.
- Each indicator within each theme is a measure against the attainment of a desired future state.
- This index has a unique development approach, including input from users, experts, policy developers and Non-Governmental Organizations.
- In addition it has incorporated theme area options, a five-phase approach and an implementation strategy.

General Comments on the Index From Participants

- The range of possible objectives for a Biodiversity Index was discussed, including excellence in biodiversity and wetland conservation targets.
- The participants thought that the term “biodiversity” should be specifically defined, as the definition will help in answering questions as to whether biodiversity is getting better or worse.
- The context of the index is also important. Is it from a human perspective? The economy? From ecosystems?
- Participants also felt that stewardship should be eliminated from the index, since it is not the goal and it gives a “self-fulfilling prospect”.
- The participants were assured that this index development incorporated lessons learned from other jurisdictions, including the Canada Water Quality Index and the experience from U.S. Environmental Protection Agency, Region 5.
- The utility of different forms of data collection and information distribution was discussed, including Geographic Information Systems and remote sensing.

There was discussion on the merit of including indicators measuring stewardship activities in the Biodiversity Index. Some felt the subjective nature of the assessment on stewardship would detract from the Canadian Biodiversity Index science base; others felt measuring progress on stewardship programs and people’s involvement in protecting habitats was an important area for policy developers and decision-makers to possibly include in this type of index.

5.5 Break-out Sessions on Cross-Cutting Issues – Day 2

Endocrine Disrupting Chemicals
Organizer: Dale Phenicie – Environmental Affairs Consulting
Facilitator: Dr. James Lamb – BBL Sciences
Recorder: Clarence Lam

General Assessment of the Break-out Session
The session included presentations on the process of assessing Endocrine Disrupting Chemicals (EDC), including impact measurement methodologies and risk assessment approaches.

The U.S. Environmental Protection Agency is developing measurement methods and risk assessment models to determine the impact of EDCs on humans and the environment. New research facilities, such as the Center for Evaluation of Risks to Human Reproduction (CERHR), have been created to research agents and risks.

It was suggested that SOLEC closely monitor EDC research (e.g. herring gull studies) for the purposes of tracking health-related indicator trends.

Technologies to Assess Endocrine Disruptors - Dr. Scott Brown
- Historical effects of persistent organic pollutants on wildlife have been identified and action has been taken to reduce exposure.
- Blue-Sac disease in Lake Ontario and Michigan is caused by exposure to TCDD. Since the banning of TCDD in the 1950s, the mortality rate due to TCDD has decreased significantly.
- The concentration and loads of most toxics have dropped at least 60% since 1986. There are many other potential sources of endocrine disruptors such as sewage, farm wastes, agricultural chemicals/runoffs, and pulp mills.
- Tons of endocrine disrupting chemical emissions occurring in the Great Lakes basin every year.
- Natural and synthetic estrogens have been found in sewage effluents; roughly 10% of all sewage plants' releases cause estrogenic activity.
- There is also androgenic and anti-androgenic activity in hormones that need to be considered. Researchers are also investigating retinoic acid receptors.
- Wildlife and fish health effects in Canadian Areas of Concern (AOCs)
    - Herring gulls studies-laboratory analysis preliminary data has shown that some male herring gulls exhibit heightened levels of vitellogenin. It is concluded that, there are definite health changes in reproduction, physiology, morphology in all stages from embryos to young adults.

Endocrine Disruptors – A View from EPA – Dr. Gary Timm
- The U.S. has a three-part approach for endocrine disruptors:
    1. Focus on research – to understand the basic science and mechanisms of action.
    2. Develop measurement methods and risk assessment models, and determine the extent of the impact of endocrine disrupting chemicals on humans and the environment.
    3. Screening assessment approach.

NTP Center for the Evaluation of Risks to Human Reproduction (CERHR) – Dr. Michael Shelby
- CERHR was established in the early 1990s.
- CERHR's goal was to provide unbiased, scientific evidence of the effects of chemicals (especially those having endocrine activity) on human development and reproduction.
- The center was created as a result of a number of cases of children born with abnormalities whose parent served in the Gulf War.

- Chemical Selection Criteria was developed for CERHR (used to determine which chemicals would be investigated by CERHR):
    - Production volume
    - Human exposure: presence in environment or in products to which members of the public are exposed
    - Data indicating potential reproductive or developmental toxicity
    - Public concern about chemical/mixture exposure
- The investigation process had three steps:
    - Chemical nomination and selection
    - Expert panel review
    - National Toxicology program transmittal
- For additional information on CERHR visit http://cerhr.niehs.nih.gov

Management Challenges and Implications

- Some of the pulp mill effluents now being discharged can definitely cause some of the effects as mentioned in Dr. Scott Brown's presentation. Consequently, monitoring and research needs to continue to address the associations of pulp mill effluent exposure with indications of effects, possibly endocrine system modulation in fish.

Traditional Ecological Knowledge

Organizer: Deb McGregor – Environmental Policy and Assessment, Environment Canada
Facilitator: Tim Thompson - Contractor, Mohawks of Wahta
Recorder: Melissa Greenwood

Abstract

SOLEC 2002 marked the second time that Great Lakes Aboriginals were invited to actively participate in the SOLEC process. While Environment Canada – Ontario Region has long acknowledged the important role that Aboriginal peoples could play in the environmental assessment and monitoring process, it was not until an internal regional Aboriginal Affairs portfolio was created, that it became clearer on how to engage and solicit the participation of Aboriginals.

At SOLEC 2000, it was evident that Aboriginals had much to contribute to the objective of better understanding the suite of Great Lakes biological indicators by sharing their repertoire of Traditional Ecological Knowledge (TEK) and Naturalized Knowledge Systems (NKS). This knowledge is derived empirically from a spiritual and intimate connection to the natural world. Mechanisms for establishing the protocols for an interaction between TEK/NKS and Western Science, was the focus of the SOLEC 2002 Aboriginal session.

At SOLEC 2002, a series of Aboriginal recommendations were derived from discussions held in two separate meeting: an Indigenous Peoples Caucus meeting and the actual conference TEK/NKS break-out session.

The First Nations' participants convened an Indigenous Caucus meeting prior to the TEK Session to examine Aboriginal involvement in the process since SOLEC 2000 and to assess future participation and contribution. Subsequent dialogue amongst conference participants followed the TEK/NKS Session that included presentations on the following three key subjects areas:

1. Participation of Aboriginal peoples in SOLEC 2000

This presentation by Michael C. Williams, Assistant Director of Nin.Da.Waab.Jig, Bkejwanong Territory discussed how the incorporation of Traditional Ecological Knowledge (TEK) in SOLEC has still not been maximized as "thousands of years of knowledge" is still missing.

Aboriginal recommendations for the SOLEC process were also discussed in this break-out session.

These recommendations include:

1. Equitable relations with First Nations and Environment Canada.
2. Want to preserve and maintain TEK, with a wider application so both sides can share the benefits of this knowledge.
3. Want long-term funding from Environment Canada.
4. Want to be recognized by all parties involved.
5. Want cultural sensitivity training for all government staff.
6. Want TEK on par with Western Science.
7. Want aboriginal inclusion in SOLEC websites and reports.
8. Want control over programs occurring within their community.
9. Need for the science to be shared with Aboriginals, and not only in the form of being given scientific reports.

This session with its recommendations indicate that much work is required to achieve effective working relationships. Aboriginals want to work with SOLEC to incorporate the concept of "Naturalized Knowledge Systems".

2. Equitable Sharing, Respect and Co-existence Between Western Science and Local TEK/NKS (case study)

This presentation by Harold Michon and John Seyler of the Anishnabek/Ontario Fisheries Resource Centre discussed success stories of how Naturalized Knowledge Systems have worked hand in hand with Western Science. These two projects used TEK and Western Science together to make management decisions in order to protect the Lake Nipigon Fishery. This presentation specifically focused on:

a. **Relationships between First Nations and how to manage fish habitats**

- TEK and Western Science
- Fish indices and management agencies in Ontario

b. **Case histories**

1. Walleye Management

- Fewer females, and it was taking more effort to catch the desired amounts of fish
- From TEK it was determined that it was taking more fish to fill up their standard fish box
- Fishery managers thought they needed the "credibility " of Western Science to confirm these suspicions
- 1995 aboriginals initiated a self-imposed closure of the fishery

2. Lake Whitefish Management

- Quotas were frozen throughout the 1990s
- There was a lack of confidence in Ontario's assessment program
- TEK understood the difference between stocks and that different stocks use different habitats; from this observation a new assessment plan was developed.

c. **Lessons Learned**

- TEK has value both scientifically and socially
  - TEK has been shown to explain variability in data (i.e. habitat utilization).
- Fishermen are the frontline observers and often see changes in the system before science (i.e. the change in fish size).
  - Thus they should be used as early "warning-systems" in order to make management decisions.
  - Using TEK has long-term benefits for all.
- TEK improves how we select indicators
  - We have come a long way in terms of how to select indicators.
  - Scientists tend to have too few "observation-based" indicators.
  - Criteria should include both TEK and Western Science; which all parties must agree upon.
- Importance of "ongoing" consultation
  - Scientists and fishermen need to listen to each other on an "ongoing" basis.
  - Fishermen/aboriginals are listened to only if there is a problem.

3. TEK/NKS and Western Science Co-existence Model.

A presentation given by Henry Lickers, Director of Environment, Akwesasne Mohawk Territory, discussed the basic themes and principles of Naturalized Knowledge Systems:

- The Earth is our mother.
- Cooperation is the way to survive.
- Knowledge is powerful only if shared.
- Responsibility is the best practice.
- Everything is connected to everything else.
- Place is important.
- The spiritual world is not distant from the Earth.
- There is a need to focus more on "life" indicators. We need to change the focus of SOLEC from the "death of species" to community health and life.

Background information from both Michael C. Williams' and Henry Lickers' presentations can be found in the paper **Linking Traditional Ecological Knowledge and SOLEC: Summary and Final Recommendations** (July, 2001), which is available on the CD which accompanies the State of the Great Lakes 2001 Report.

Atmospheric Indicators

Organizer: Don McKay – Air Quality Research Branch, Environment Canada
Facilitator: Vicki Thomas – Great Lakes National Program Office, United States Environmental Protection Agency
Recorder: Dominique Jones

About the Proposed Indicators

- The underlying equation for the "atmospheric deposition of toxic chemicals" indicator needs to be clarified. The indicator should be "held" until this clarification is made and accepted.
- Questions were posed regarding the air quality indicator. Participants wondered if this indicator included backyard and woodstove burning emissions?
- Questions also arose regarding the acid rain indicator: Does the equation adequately describe the inputs? And should we revisit the critical loading issue?
- A new smog indicator was recommended. In border areas, the U.S. and Canadian mechanisms for reporting on smog days should be harmonized to make this indicator more meaningful for the public.

- Other key considerations for this new indicator: use lichen as indicator as it is sensitive to smog, and should we track exceedances rather than advisories.

Comments on Specific Indicators

- Atmospheric Deposition of Toxic Chemicals
    - This indicator is used to estimate the average annual loadings of toxic chemicals from the atmosphere to the Great Lakes.
    - Need to determine the level of contamination in air/water that are safe for people to consume.
    - Endpoints for air deposition need to be identified.
    - It was the opinion of the International Air Quality Advisory Board (IAQAB) that the specific equations used in this proposed indicator are not indicative of the variety of methodologies that are currently in use; thus the general consensus from this session was that alternative calculations need to be considered when estimating toxic chemical deposition.
    - Session participants questioned the variability of Lake Michigan PCB deposition patterns from a Lake Michigan mass balance study by Hornbuckel and Green (2000) and a discussion on the limited applicability of data from monitoring stations of the Great Lakes, as reported by the International Joint Commissions' (IJC) 11th annual report.
    - The source apportionment of specific contaminants was also discussed in this session. The main focus was on backyard and woodstove burning as a source of dioxins as reported by the U.S. Environmental Protection Agency.
- Human Health Indicator – Air Quality
    - SOLEC's purpose is to develop an indicator that infers the potential impact of air quality on human health in the Great Lakes region.
    - It was suggested that air toxics (such as benzene and formaldehyde) in addition to the standard pollutants (SO_2, CO, O_3) be used in the indicator assessment.
    - Studies have clearly established that pollutants existing in the ambient air affect human health. This session discussed the impact of fine particulate matter and ozone on the human respiratory system and its link to hospital admissions.
    - The board initially suggested that Extractable Organic Carbon (EOC) could be used to determine the presence and significance of hazardous air pollutants that affect human health. However, after discussion in the break-out session, it was determined that further research on EOC needs to be completed before it is used for measurement.
- Human Health Indicator – Acid Rain
    - The goal of this indicator is to eliminate major acid rain pollutants by reducing emissions of acidifying contaminants such as sulphur dioxide and nitrogen oxides.
    - Specifically, this Great Lakes indicator is designed to assess pH levels and critical loadings of sulphate in the Great Lakes basin; and to infer policy effectiveness in the reduction of sulphur and nitrogen acidic compounds released into the air.
    - In discussing nitrogen deposition in the Great Lakes, participants agreed that more focus should be placed on this component of acid rain, as this component has not been reduced to the extent of its sulphate counterpart.
    - The board responded to this indicator by noting that the use of pH is not entirely indicative of the effect of acidity and individual acid rain components in the environment
        - Biological organisms respond to pH as a parameter, although the environment as a whole does not exhibit a significant response to pH.
        - Acid Neutralizing Capacity (ANC) was suggested as a more useful measurement when determining the effect of acid rain on the environment.

- The concept of critical load was also discussed in this session; participants and organizers provided some comments and problems with this measurement.
    - This measure is site specific and allows for calculations of loadings in any ecosystem and some determination of what the system can with stand.
    - There are some problems with this concept including: general uncertainties; assumptions of the model; the dose-response relationships used to select the critical chemical values are not necessarily transferable between regions or water bodies; and episodicity is very difficult to predict.
    - Participants suggested that work should be continued on the quantification of spatial representativeness by developing techniques to provide inventories of the population of ecosystems and to model the distribution of critical loads and exceedences amongst the whole population.
    - Participants also recommended that definitions of exceedances are developed for the indicator, and that uncertainty analysis of models needs to be conducted.
- Proposed Indicator – Smog Advisory
    - This indicator has been proposed in order to develop a common alerting and indicative system for smog advisory along the U.S./Canada border, including the Great Lakes basin.
    - Developments in smog advisories and reporting were presented in this session from examples in Ontario, Michigan, British Columbia and the Atlantic Provinces.
    - It was concluded that although standards in the two countries would likely remain distinct, it was agreed that the further harmonization of ambient monitoring and co-operative refinement of smog advisories could allow for a comparable advisory system for all the Great Lakes.

Brominated Flame Retardants
Facilitator: Bob Campbell – Great Lakes Chemical Corporation

Summary of Break-out Session

- What are Bromintated Flame Retardants (BFRs)?
    - They are a generic family of compounds used to impart ignition resistance to a polymeric matrix.
    - There are many structural classes of brominated flame retardants and they exhibit different chemical and physical properties; including persistence, bioaccumulation and toxicity.
    - Different BFR products are needed for different polymers.
    - Some common types include: Brominated diphenylethers (PBDEs) and Tetrabromobisphenol A (TBBPA).
- Why do we have BFRs?
    - Prevent deaths, injury and environmental pollution caused by fires.
    - BFRs allow for the highest safety standards to be met in electronics and furnishings.
    - A European Union Commission stated, “in the last 10 years there has been a 20% reduction in fire deaths as a result of using flame retardants.”
- Why is there a reason for concern regarding BFRs?
    - CERTAIN BFRs are found in the environment.
    - Most BFRs are persistent.
    - A few have the potential to bioaccumulate.

    - Problems could arise if all BFRs are treated similarly, as there are many structural classes of flame retardants and they exhibit different chemical and physical properties; including persistence, bioaccumulation and toxicity.
- BFR manufacturers share the concern:
    - These companies fully co-operate with risk assessments.
    - They are carrying out extensive studies on BFRs environmental and human health effects.
    - Product stewardship programs are designed to limit intrusion into the environment.
- BFR industries have the agreed to the following commitments:
    1. Continue studies of BFR effects on human health and the environment.
    2. Address regulatory questions in a timely manner.
    3. Enhance product stewardship in order to assure minimum intrusion into ecosystems.
    4. Work with environmentalists and regulators to assure safe use of products.
- For additional information on BFR industries please refer to the following websites:
    - http://www.BSEF.com (Bromine Science and Environmental Forum)
    - http://www.EBFRIP.org (European Brominated Flame Retardant Industry Panel)
    - http://www.Cefic.EFRA.org (European Flame Retardant Association)

5.6 Memorable Quotations

The following are memorable quotations heard within SOLEC 2002 break-out sessions and captured by the session recorders or they are quotations taken directly from SOLEC 2002 Evaluation Surveys.

1. From the Introduction to Indicators Session – “Indicators 101 – excellent!! Helps pass the baton to next generation”.
2. From the Ecological Data Trends Session – “The panel on Ecological Data Trends was the most interesting event at SOLEC, do more of this next time”.
3. From Index Development Session – “The benefit of SOLEC is that it brings managers and scientists together to learn from each other”.
4. From the Endocrine Disrupting Chemicals Session – “If you do not measure it, you cannot manage it”.
5. From the Groundwater Indicators Session (regarding water efficiency) – “How can we argue to keep water from the Great Lakes from other countries if it appears that we are squandering it ourselves?”
6. From the Groundwater Indicators Session (regarding the hydrologic cycle) – “We have re-plumbed the entire Great Lakes water system”.
7. From the Traditional Ecological Knowledge Session – “We have to understand each other and respect each other in order to communicate effectively”.
8. From the Unbounded and Under Construction break-out session – “We are the biggest invasive species”.
9. SOLEC offers an excellent opportunity to learn about what other lake management systems are doing, so we begin comparing apples to apples – nationally, binationally and worldwide.
10. Overall, improved from 2000 – well worth attending.

6. SOLEC Success Story Recipients

Since 1996, the State of the Lakes Ecosystem Conference Steering Committee has honoured various organizations and agencies with a SOLEC Success Story award. These organizations are selected as they have exemplified a strong commitment to improving the environment within the Great Lakes basin. For SOLEC 2002, the following criteria were used to select the award recipients:

- Showed improvement in the "integrity" of the Great Lakes or local ecosystem, with a focus on "biological integrity"
- Forged linkages among economy, environment, and community
- Created a "win-win" situation
- Formed strong partnerships
- Established sustainability as a goal
- Fostered broad stakeholder involvement
- Demonstrated adequate monitoring of effectiveness

Chicago Wilderness

Chicago Wilderness is 200,000 acres of protected conservation land including woodlands, wetlands, prairies and dunes. It is also a larger matrix of public and private lands that support and protect nature in this region. The boundaries of Chicago Wilderness capture a spectacular concentration of rare ecosystem types that harbor a high diversity of species, including a large number of those listed as threatened or endangered. The purpose of the Chicago Wilderness collaboration, 150 plus agencies and organizations, is to sustain, restore, and expand remnant natural communities. A Biodiversity Recovery Plan, which recommends a number of preservation, management and protection actions, was adopted by the Chicago Wilderness collaboration. This will assist the collaboration in reaching the goals of establishing a broad policy of beneficial coexistence in which the region's natural heritage is preserved, improved, and expanded even as the metropolis grows. Professional expertise and thousands of citizen volunteers are transforming this region into the world's first urban bioreserve, a metropolitan area where people live in harmony with rare and valuable nature. Managers from several agencies and organizations have also organized a coalition of business and industries to begin to assess corporate lands as potential restoration sites, as well as solicit corporate funds for future projects. Chicago Wilderness is a model for improving ecological integrity through expansive partnerships and stakeholder involvement.

Humber Bay Shores Projects

Close to the mouth of the Humber River, a tributary to the Toronto Waterfront, the Toronto and Region Conservation Authority (TRCA), has restored approximately 3000 metres of shoreline adjacent to a former motel strip on the west side of Toronto. The TRCA led a partnership of agencies to develop an amenity scheme to replace lost aquatic habitat and to provide a public park with access to Lake Ontario. Suitable for local wave conditions, the habitat components included cobble beaches, offshore islands, sheltered shorelines, and a wetland complex. The cobble beaches, important fish-spawning areas, were secured and protected by a series of "T"-

shaped headlands. Shoals, reefs and random-placed rocks attached to the headlands, attract and hold pelagic fish. Islands, planted with shrubs, provide sheltered backwaters, with large clusters of woody material anchored to backshores. Closing an existing embayment with a rock-rubble berm formed the three-hectare wetland complex. The shoreline was graded and inoculated with plants to create a shrub buffer, sedge strand and colonies of emergent, submergent, and floating vegetation. Logs, log cribs, stumps and entire trees plus a braided channel provide spawning and rearing habitat for fish, especially pike. Soon after the embayment was closed, some of the bare shoreline attracted Caspian Terns, so the original plan was altered to leave this area without vegetation. As well, a veneer of sand and gravel was laid to mimic the backshore beach feature preferred by nesting Caspian Terns. The fish community has responded immediately, with an overall increase in abundance and biomass of adult fish, as well as large schools of fry and juvenile fish using the nearshore areas of the wetland and islands.

Lachine Rapids Coordinating Committee

A working group and action plan were established in 1997 to deal with the conflicting activities (such as boating versus wildlife observation) in the vicinity of the Lachine Rapids, south of the island of Montréal. The conflicting issues were threatening the environment and resources in this region. During the following years, recommendations have been met by finding solutions that are acceptable/suitable to all stakeholders. Other users are now aware of the environmental issues and follow this action plan's example. The general public can now benefit from the numerous conservation activities undertaken to protect and restore sensitive habitats. The goal for sustainable development in this region ensured that the protection of the bird sanctuary, the fish spawning grounds and the wetlands, could be secured without eliminating the boating companies and losing the economic benefits associated with boating activities in the region. In a relatively short period, the stakeholders have demonstrated their ability to resolve the many problems brought about by the conflicting uses in this area. This initiative exemplifies the need to involve all concerned parties in attempts to resolve issues of environmental conservation.

National Council for Air and Stream Improvement, Inc.

The National Council for Air and Stream Improvement, Inc.'s mission is to address, through a highly focused research program, the environmental information needs of the forest products industry. Although its initial focus was on assisting the pulp and paper industry in addressing wastewater treatment issues, NCASI's programs have expanded over the years into every aspect of environmental quality protection of relevance to the forest products industry. In the 1970s, the research program grew to address environmental issues associated with forest management practices and the manufacture of solid wood products. In 1990, NCASI organized its Eastern Wildlife Program to: "*Provide sound science and technology that objectively characterizes relationships between forest management and plant and animal communities, and supports innovative, cost-effective management strategies that benefit fish and wildlife."* Today, NCASI and its Eastern Wildlife Program serve as an environmental resource for the forest products industry in its broadest definition, addressing myriad issues of importance to the industry both bi-nationally and in the Great Lakes region. The program monitors wildlife trends in forestlands used by the industry including studies on the northern goshawks in the Great Lakes region and breeding bird communities in Michigan. The project was designed to provide sound science and technology that characterizes the relationship between forest management and plant and animal communities and supports innovative, cost-effective management strategies that benefit fish and wildlife.

Nicolet Hardwood Corporation

Nicolet Hardwood Corporation, Laona, Wisconsin**,** is a family owned corporation that has been dedicated to promoting sustainable forest management for over 125 years. For more than 70 years, Nicolet has practiced multiple-use, sustained yield forest management, focusing on selective harvesting on most of their forestland. This practice not only provides a continuous supply of timber, but also satisfies many wildlife and biodiversity objectives, and maintains forest aesthetics. Nicolet demonstrates its commitment to sustainable forestry in many ways. On newly acquired lands, they implement a distribution representing all age classes. Nicolet also invests in ways to improve and quickly regenerate poor production areas, and utilize research to increase the growth of Sugar Maples in selected stands. In addition, recent investments in state-of-the-art sawmill technology assure maximum wood utilization. Sustainable forest management must include equal connection to the economy, the environment and community. Nicolet's timber management practices provide maximum timber production, proper wildlife management and many recreation opportunities for the public. Their past practices coupled with their recent implementation of the American Forest and Paper Association's Sustainable Initiative (SFI)^{SM} Program establishes them as leaders of sustainable forestry in the Great Lakes' states.

Springfield Township

Springfield Township, Oakland County, Michigan has a strong commitment, through its evolving land use policies and practices, to protect and preserve its natural resources. The Township initiated a series of projects, beginning with the development of a Master Plan. This plan includes a long range statement of general goals and policies aimed at the unified and coordinated development of the Township; provides the basis upon which zoning and land use decisions are made; and includes strong emphasis on natural resource systems as determinant for land use planning. Springfield Township has shown leadership in recognizing the importance of significant local natural resources to the health of their community. The Township also learned about these natural resources and incorporated this information into the plans while working with local developers and landowners to ensure cooperation and results. The Township's understanding that surrounding communities in the four watersheds are important to the success of its comprehensive plan, led to partnerships and projects with both other townships and with Oakland County. The Township involved local citizens by encouraging the use of native vegetation. To date, thousands of copies of the native vegetation CD have been distributed. The effectiveness of the Township's initiatives can be measured by the continuing influx of requests for this CD; by the support given by local developers to the new zoning policies; and by requests from other communities to help them establish similar policies and programs throughout southeast Michigan.

7. Conference Closing Remarks

Gary Gulezian
Director of Great Lakes National Program Office
United States Environmental Protection Agency, Region 5

Michael Goffin
Director Great Lakes Corporate Affairs
Environment Canada, Ontario Region

Delivered on Friday, October 18, 2002

[GARY] Thank you Harvey. And a big thank you to our two Co-Chairs, Harvey Shear and Paul Horvatin. Harvey and Paul have worked tirelessly to direct and co-ordinate five Conferences – and I suspect, they have already begun to plan the next one. Along with the hard work of scientists and planners, the success of these events is in large part due to the friendship these two have developed over the past years. This friendship is the best reflection of the collaboration between our two countries, as we celebrate 30 years of partnership in implementing the Great Lakes Water Quality Agreement.

In closing, I am reminded of the charge that John Mills gave at SOLEC 2000 – where he challenged us to further develop the swimmability, fishability and drinkability assessments, that we began to report on at that conference.

Now, we really have these three categories on a solid footing – such that they are contributing to decisions that are made. These Great Lakes ecosystem assessments have galvanized the relationship between science and public policy: they are a gateway to informing our decisions – and there are tangible examples of how they are being implemented by the most senior managers.

These three areas – fish, swim, drink - provide managers with the opportunity to communicate to our constituents – the public, the media and the politicians. And we must be certain that we continue our focus on the most important and relevant issues in the public mind. But we must also be cautious when we rate issues as “mixed” or “good”, since these are averages and provide direction, but they do not necessarily apply at the local level.

Two years ago, we endorsed a planned reporting cycle for SOLEC – first, we would focus on Biological Integrity – and we have come a long way to enabling the Parties first report on this subject. Next, we would move to the Physical Integrity of the basin. And lastly, we would focus on Chemical integrity – to be discussed at SOLEC 2006.

We were fortunate in our planning in some ways – that the focus of this conference would be the development of biological integrity indicators. In other ways, our timeliness was unfortunate, since the impact of non-native species on our ecosystem (and particularly in Lake Erie) has spurred us to action, particularly over this past summer. Little did we know when we planned this focus, that we would be tackling the very difficult issues of botulism, Asian Carp, and declining scud. We must move quickly to anticipate and prevent further invasions, and be entrepreneurial in our actions to control the species that are threatening our valued ecosystem.

On a personal note, I would like to thank you all for coming and contributing your ideas and knowledge.

[MICHAEL] At SOLEC 2004, we will focus on developing indicators for physical integrity. Along with the impact of non-native species, a resounding theme over the past two days, was the

impact on the Great Lakes from human activities and urban sprawl. These are challenging, and often contentious issues. As we move onto the land and upstream to the headwaters, we must look towards encouraging additional experts and partners to join with us in this process. Particularly since combined sewer overflows and storm water are issues faced by our friends in local authorities and watershed planning agencies.

But, we are more aware of these issues today, because of the successes and improvements we have made in other areas. In many ways, we have raised the bar – let's think about – when you have a burning river, you don't even think about wanting to swim in it.

And, as we tackle both new and old challenges, we must celebrate the positive results from the work that has been done. We have gathered here together to discuss problems as well as share successes from our work – both as governments, and stakeholders alike. And we should congratulate ourselves on these results, even though there is much more to be done.

On behalf of Gary and myself, and our two co-chairs, I would like to express our thanks and gratitude for your excellent contribution to this conference. The results will contribute to the Parties State of the Great Lakes 2003 report.

I invite you to join us in 2004 in southwestern Ontario, where we can again meet to discuss problems, and celebrate our successes.

Thank You.

Appendices

Appendix A – SOLEC 2002 Agenda

The conference agenda for SOLEC 2002 can be found on the next two pages.

SOLEC 2002

Overview

As Parties to the Great Lakes Water Quality Agreement, the governments of Canada and the United States are responsible for accurate reporting on the state of the Great Lakes. The State of the Lakes Ecosystem Conference is a result of this commitment to reporting. With the establishment of a consistent suite of ecosystem indicators, the health of the Great Lakes basin can be objectively assessed. Regular reporting of a core set of indicators will promote more efficient and successful management as well as creating more accessible information for policy makers and the public.

The first two conferences in 1994 and 1996 developed a series of *ad hoc* indicators to evaluate the state of various Great Lakes ecosystem components. SOLEC 98 went beyond the previous SOLECs and presented a comprehensive list of ecosystem indicators for review and discussion. This suite of indicators objectively represents the state of the Lakes while establishing consistent biennial reporting. SOLEC 2000 began the actual assessment of the state of the Great Lakes using the suite of indicators.

SOLEC 2002 will focus on continuing to update and assess the state of the Great Lakes using the suite of indicators with an emphasis on biological integrity.

For additional information on SOLEC 2002 please contact:

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SOLEC 2002

Steering Committee

SOLEC Steering Committee members represent a wide variety of agencies from around the Great Lakes:

Agency for Toxic Substances & Disease Registry
Council of Great Lakes Industries
Environment Canada
Great Lakes Commission
Great Lakes Fishery Commission
International Joint Commission
Michigan Department of Environmental Quality
Minnesota Pollution Control Agency
Natural Resources Canada
NY State Department of Environmental Conservation
Ontario Ministry of Agriculture, Food & Rural Affairs
Ontario Ministry of Environment
Ontario Ministry of Natural Resources
Pennsylvania Department of Environmental Protection
Tribes/First Nations
U.S. Environmental Protection Agency
U.S. Fish & Wildlife Service
U.S. Forest Service
U.S. Geological Survey
U.S. National Park Service

There are many other individuals and representatives from environmental groups, academia and local governments who have participated in the work necessary to develop this conference.

SOLEC 2002

State of the Lakes Ecosystem Conference 2002

Biological Integrity of the Great Lakes

October 16, 17, & 18, 2002
Cleveland Convention Center
Cleveland, Ohio

Hosted by:

Environment Canada
&
United States Environmental Protection Agency

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Tuesday October 15, 2002

An **evening reception** will take place at the Sheraton Cleveland City Centre Hotel

Hors d'oeuvres & refreshments provided

Sponsored by Great Lakes Commission

DAY ONE - Wednesday October 16, 2002

Cleveland Convention Center
10:00 PLENARY
State of the Great Lakes & Management Implications

Lunch at Sheraton Cleveland City Centre Hotel

Cleveland Convention Center
1:30 Network Time

OR

1:30 Introduction to Indicators
(SOLEC Indicator Process Review)

2:00 Concurrent Sessions
In depth discussion about the state of the Great Lakes based on indicators

- Nearshore & Open Waters
- Coastal Wetlands
- Land & Land Use
- Societal
- Human Health
- Other

5:00 Adjourn

DAY TWO - Thursday October 17, 2002

Cleveland Convention Center
8:30 PLENARY

Biological Integrity
- an assessment of the Biological Integrity of the Great Lakes including some rehabilitation case studies

Societal Responsibility, Groundwater & Other New Indicators

Lunch at Sheraton Cleveland City Centre Hotel

Cleveland Convention Center
12:45 Concurrent Sessions on New Indicators

- Biological Integrity
- Societal Responsibility
- Groundwater
- Forestry
- Agriculture
- Other New Indicators
- Developing Indices

3:15 Concurrent Sessions on New Indicators & Cross-Cutting Issues

Cross- Cutting Issues Include: Implementing Traditional Ecological Knowledge (TEK), Endocrine Disrupting Chemicals, Monitoring, and Environmental Trends Data

5:15 Adjourn

Dinner at Sheraton Cleveland City Centre Hotel

6:00 Cash Bar Opens

7:30 Dinner
- Recognition of Success Stories
- Slide Presentation

DAY THREE - Friday October 18, 2002

Cleveland Convention Center
8:30 PLENARY
Ecosystem Status Reports

Lake & Connecting Channels Presentations
- with a focus on biological integrity

Fishery Reports
- for Lake Huron & Lake Superior

11:15 CONFERENCE WRAP UP

12:15 Adjourn

Registration packages can be picked up on:

Tues.Oct.15, 7:00 pm - 9:00 pm

or

Wed.Oct.16, 7:30 am - 12 noon

For more information on SOLEC 2002 visit:

www.binational.net

Appendix B – Participant Profile

Country	Number of Delegates Attending	Percent
United States of America	238	62.98
Canada	129	34.13
Japan	5	1.32
Mexico	3	0.79
Latvia	1	0.26
Estonia	1	0.26
Lithuania	1	0.26
Total	378	100

Sector	Number of Attending Delegates	Percent
Federal Government	138	36.51
Provincial/State Government	46	12.18
Academia/Research	38	10.05
Environmental Groups	37	9.79
Commissions	31	8.20
Industry	19	5.03
Consulting	19	5.03
Native/First Nations	15	3.95
Conservation Authorities	13	3.44
Municipal Government	11	2.91
Media	5	1.32
Professional Associations/Societies	4	1.06
Other	2	0.53
Total	378	100

Appendix C – SOLEC 2002 Participant List

The SOLEC 2002 Participant List can be found on the next nine pages.

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Appendix D – Participant Feedback Summary

The following information is based on the 74 participant responses to the SOLEC 2002 Evaluation Form with the information being broken down into four main categories.

Key Conference Indicator
Participants were asked the question ”Did the information you received at SOLEC 2002 enhance your ability to preserve, protect and restore the Great Lakes?” The majority of the respondents **73%**, felt that SOLEC 2002 “somewhat to very much” provided information to enhance their ability to preserve, protect and restore the Great Lakes, while only **17%** of respondents felt that the conference had not enhanced their ability to improve the ecosystem. Some respondents would have preferred “reporting out on data and a stronger presentation on the state of the Lakes, rather than indicator validation”.

Plenary
For all three days, over **65%** of the respondents felt that the plenary sessions covered the topics well or very well, and provided new information. In addition, over **70%** of respondents felt that the plenary sessions were useful or very useful, with respondents commenting, “the plenary session was excellent”, “high quality talks and speakers were well prepared”. In contrast, some comments received regarding SOLEC 2002 plenary sessions were negative: “more time is needed for questions and answers” and “some slides were not readable by most in the room”. With regards to the Day 3 plenary of SOLEC, many respondents felt that the LaMP and fishery presentations should have been presented on Day 1.

Break-out Sessions
Forty-three percent of the respondents felt that the in-depth indicator break-out sessions covered their topics well or very well. However, some of the respondents still felt that the break-out sessions had “no clear agenda” and “there were poor instructions for participants”.

In addition, **46%** of respondents felt that the break-out sessions were useful or very useful. Some comments included: “the break-out sessions that I attended were excellent with great discussions”, “Indicators 101 – excellent!! This sessions helps to pass the baton to the next generation”, and another respondent felt “the panel on ecological data trends was the most interesting event at this SOLEC”. Other comments provided on the usefulness of break-out sessions included a need to have “experts on hand during the session, including the need for social scientists, to explain some indicators” and “break-out sessions should be information sessions rather than discussion based sessions”. Participants also felt that organizers should “encourage participants to read indicator reports ahead of time to make future break-out sessions more productive”. Comments were also provided regarding specific break-out sessions, for example, “the endocrine disrupting chemical presentation was too technical and only understood by a few” and “the break-out sessions and report information on societal indicators was somewhat confusing”.

The majority of respondents, **55%**, felt that the break-out sessions provided the adequate amount of time for discussion of indicators. Many respondents felt that there was “adequate time for some of the break-out sessions, such as atmospheric deposition, but too short of time for human health and societal indicators sessions”. Some other comments on the amount of discussion time for SOLEC 2002 break-out sessions included: “small group discussions were good, larger group discussions were too long” and “break-out sessions need a brief overview of each of the topics before the group discusses them”.

General
Over **64%** of the respondents agree or strongly agree that SOLEC provides valuable information and continues to serve a vital function. The majority of respondents, **75%**, agreed or strongly agreed that the conference was well organized. Some items of improvement for registration at the next SOLEC will be to provide: “a list of participants to improve networking”, “an email confirmation of registration” and an improved SOLEC registration website.

With regards to the printed materials provided to conference participants, **70%** of respondents agreed or strongly agreed that this material was useful. Many respondents felt that these documents, including presentations, “need to be available a month in advance of SOLEC to allow for sufficient background information, for discussions in the session”. Many also felt that “the documents need to be more easily accessed on the web”.

Participants were also asked if they found the conference program and newsletter useful and informative. Over **60%** of respondents agreed or strongly agreed that this material was useful and helpful. However, one respondent suggested that a “detailed agenda should be sent out earlier to aid with funding and approval for SOLEC participants”. Several suggestions made by respondents indicated that more information is needed about topics being covered in the sessions.

Once again, participants felt the display and poster session was informative with **69%** of the respondents agreeing or strongly agreeing that they were useful. However, despite the usefulness of these displays, most respondents felt that these displays were “inconveniently located”.