HABITAT 2001

A Workshop on the Future of Habitat Restoration and Protection on the Upper Great Lakes

February 25-27, 1997
Sault Ste. Marie, Ontario

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Executive Summary

HABITAT 2001, a workshop on the future of habitat restoration and protection in the Upper Great Lakes, was held in Sault Ste. Marie, Ontario from February 25-27, 1997. In attendance were over 50 professionals from around Lakes Huron, Michigan and Superior who have an interest in aquatic and terrestrial habitat issues. The workshop, which consisted of presentations, panel discussions and breakout sessions, was designed to inform participants of advances in habitat science and technology in the Upper Great Lakes, to present lessons from ongoing habitat projects and initiatives, and to provide a forum for discussing the next steps in setting environmental objectives and indicators for each of the three lakes.

David Dempsey, a Commissioner with the Great Lakes Fishery Commission, gave the opening address for the workshop. Dempsey drew an analogy between the Great Lakes pollution crisis of the 1960s and 1970s and the Great Lakes habitat crisis of today. Factors which contributed to success in dealing with pollution at that time included dedication of substantial funding to pollution issues and immediate action taken to control harmful substances, often before final proof of deleterious effects was available. Dempsey called on the assembled participants to provide a clear direction with the message, '**a healthy Great Lakes system cannot be sustained with current habitat loss trends**'.

Through a number of presentations, participants were informed about developments in habitat science and new habitat projects in the Upper Great Lakes covering such topics as modifying navigation structures to provide a greater diversity of aquatic habitat and developing a GIS data base to support habitat initiatives in Lake Superior. Three initiatives with broad-scale applicability in the Great Lakes basin were outlined: a) the State of the Lakes Ecosystem Conference for 1998 to develop a common set of ecosystem indicators, b) the process used to develop Remedial Action Plans (RAPs) and involve communities in multi-stakeholder consultations, which has been suggested as a model for community action in other locations on the Great Lakes, and c) a framework for guiding habitat rehabilitation in the Great Lake Areas of Concern (AOC), outlining concrete rehabilitation targets.

The first of two panel discussions addressed the question, "Why are we still losing habitat and how can we reverse this?". The current regulations often allow compensation rather than requiring mitigation techniques, and compensation may be with habitat of unequal or unknown value. Important habitat gets whittled away bit by bit. The effectiveness of the regulations is reduced through consideration of projects on a site-by-site basis rather than on a broader scale, the desire of government agencies to avoid confrontation, and cuts in funding for enforcement. There is a lack of public support for government conservation of habitat because of frustration with an inflexible permitting process that often is not applied in a way that habitat is actually protected. One approach is for agencies to work with municipalities and other stakeholders to develop land use plans which identify areas that may be developed and areas of important habitat which require protection.

The remainder of the workshop looked at the planning process for developing goals, objectives and indicators for the Upper Great Lakes. Each of the Upper Great Lakes, Superior, Huron and Michigan, are at a very different stage in developing management plans which are applicable to the whole lake. Presentations outlined 3 aspects of developing lakewide plans: the process of developing the Lakewide Management Plan for Lake Michigan, a description of the ongoing process to define objectives and indicators of ecosystem sustainability for Lake Superior, and the principles used for Lake Huron to develop Fish Community Objectives (FCOs).

Some of the principles to consider when developing objectives and indicators were discussed during breakout sessions focussing on Fish Community Objectives and on Land-Water Linkages.

> Fish Community Objectives: There is a need to move from "use"-based to ecosystem-based objectives. In many cases, enough information is known on which to base management objectives but the objectives actually chosen are affected by differences in the information base and resource use in different jurisdictions. For lakes where more than one set of objectives have been developed (for example, fish community objectives and ecosystem objectives for Lake Superior) these objectives should be compatible and integrated. There is a need to identify priorities and a timetable for implementation.
>
> Linking Aquatic and Terrestrial Ecosystems: Planning at a local, watershed level is the level at which the general public and appropriate interest groups can get involved most effectively, and provides one way to link larger scale aquatic and terrestrial objectives. Local planning is bounded by broader terrestrial and lakewide objectives. There is a need for greater interaction and communication between aquatic and terrestrial managers.

A second panel furthered discussion about moving from broad ecosystem objectives to quantifiable environmental objectives and indicators. Presentations by panelists included a summary of efforts to establish a joint monitoring process for Lake Superior, an overview of SOLEC'98 (State of the Lakes Ecosystem Conference) which will define one set of indicators for the Great Lakes, and a look at the process to link environmental objectives with Fish Community Objectives in Lake Superior.

The final breakout sessions offered an opportunity to discuss the next steps for each of the Upper Great Lakes to move towards quantified objectives and indicators.

Lake Superior

The Lake Superior discussion formulated the next steps of how to move from the existing Ecosystem Principles and Objectives to an on-the-ground monitoring effort. The people who should ideally be involved in this process were listed and possible roles were suggested for academia, volunteers, protected area managers, Lake Superior Ecosystem Cooperative, First Nations, water quality and other resource agencies.

Recommendations

- The Fish Community Objectives and the Aquatic Community Objectives from the Ecosystem Principles and Objectives should be unified.
- Revisions to the Ecosystem Principles and Objectives should consider both existing and potential monitoring initiatives.
- There is a need for upper management in agencies to provide the same level of support for the Lakewide Management Planning process as for the Sustainable Forestry initiatives if there is to be effective integration of the two.
- Involvement in a basin-wide monitoring program must be developed on an on-going basis. There are a wide variety of groups which could potentially be involved to some degree in carrying out a portion of a monitoring program.
- A group like the Lake Superior Binational Forum should be approached to coordinate monitoring efforts by volunteers around the basin.

Lake Michigan

Much of the discussion about the next steps for developing ecosystem and environmental objectives for Lake Michigan focused on the redevelopment of a Stage One LaMP document for the lake. One of the most important aspects of developing a lakewide plan is the involvement of stakeholders in the process.

Recommendations

- There must be cooperation between the LaMP Technical Committee (TCC) and the Fisheries Commission Technical Committee (FCTC) during the LaMP process.

- Building relationships around the Lake Michigan basin is more important to the success of lake management planning than the actual LaMP document which will be produced in the next year. Development of a workable Lakewide Management Plan is an iterative process. The LaMP document to be produced this year (1997) must be considered as just the first step in a process which will make many changes to this draft document.
- It is essential to bring in an aspect of land use and land stewardship into the LaMP. In areas with a large population base, these links may best be developed on a watershed by watershed basis using watershed management councils to involve the appropriate people. In areas of less population, riparian owners, including timber companies and railroads, should be involved.

Lake Huron

Lake Huron has not yet begun the process of developing a Lakewide Management Plan. The discussions at this breakout session were a first step in that development process. Some lakewide initiatives, such as Fish Community Objectives or Remedial Action Plans, are already in place and may provide some guidance. LaMP efforts on Lake Superior may be used as a model to provide a starting point.

Recommendations

- The next step in development of a LaMP could involve a workshop to define the status of habitat in the lake and develop habitat objectives and targets.
- A scoping meeting is needed to address ecosystem objectives for the lake.

Acknowledgements

The workshop organizers would like to thank the many individuals who contributed to making this event a success. Thanks to all the presenters and panel members for sharing their insights and information with others concerned with habitat issues in the basin. A special thanks to Karen Holland and Pat Collins for helping with workshop facilitation, and to all the participants who contributed to the discussions. We also wish to thank Lorne Kraft, Marilee Chase and Tim Cano for assisting with the conference preparation and logistics and for recording the discussions from the breakout sessions. The Steering Committee for this workshop consisted of: Charlie Wooley, USFWS; Marg Dochoda, GLFC; John Hartig, IJC; Doug Dodge, OMNR; John Kelso, DFO; Bill Horns, WI DNR; and Ed Iwachewski (Chair), OMNR.

We would also like to thank our many sponsors for this event:

- Habitat Advisory Board of the Great Lakes Fishery Commission
- Environment Canada - Great Lakes 2000 Clean-up Fund
- HabCARES Steering Committee
- Water Quality Board of the International Joint Commission
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- Ontario Ministry of Natural Resources
- Habitat Committee of the Lake Superior Binational Program
- Lake Superior Programs Office.

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Introduction

Ed Iwachewski, Chair - HABITAT 2001
Ontario Ministry of Natural Resources, Lake Superior Programs Office

HABITAT 2001 was a workshop on the future of habitat management on the Upper Great Lakes. The workshop title plays on Arthur C. Clarke's "2001" as we look towards the future and the next millennium. It also refers to Environment Canada's "Great Lakes 2000" program, which has been a leading force in habitat restoration on the Canadian side of the Great Lakes. The idea for HABITAT 2001 resulted from the strong demand to continue and expand upon the technology transfer process initiated after the HabCARES Conference (November, 1994). The first tech transfer session (Romulus, Michigan - April 1995) focused on the Lower Lakes, Erie and Ontario, while this second session targeted the Upper Great Lakes, Huron, Michigan and Superior.

HABITAT 2001 drew from the lessons gained through other events like the Environmental Objectives Workshop (Great Lakes Fishery Commission, Habitat Advisory Board - 1993), the State of the Lakes Ecosystem Conferences (SOLEC - 1994, 1996), and the Lake Superior Habitat Workshop (1996). The goals of HABITAT 2001 were to answer key questions facing us at this time such as:

- how can we set and achieve habitat objectives on a lakewide scale or to delist our Areas of Concern, especially in a tight fiscal environment?
- how can we develop strong linkages between terrestrial and aquatic habitats?
- what kinds of information are required (and what is available) to allow derivation of environmental objectives for the Upper Great Lakes?
- what's new in habitat science and technology that can help us?
- what new projects are of interest in the Upper Lakes?
- if habitat is so important, how come we are still losing so much?

HABITAT 2001 was open to a wide audience, which included resource managers, lake technical committee members, biologists and technicians, Remedial Action Plan and Lakewide Management Plan participants and anyone wishing to gain some understanding of the current state of the science and art of habitat restoration.

Through the generous sponsorship of a variety of agencies and organizations we were able to come together and meet many of the workshop goals. We must each endeavour to maintain the enthusiasm and energy displayed at HABITAT 2001 in achieving our habitat goals on the ground and meeting the challenges before us.

Opening Remarks

Dave Dempsey, Commissioner
Great Lakes Fishery Commission

I speak not just as a member of the Great Lakes Fishery Commission but also as a citizen of the Great Lakes Basin. I speak as a citizen, to professionals; as a policy analyst, to professionals. And I ask: why are we still losing habitat? And I say: you are critical to saving habitat.

I draw an analogy between the Great Lakes pollution crisis of the 1960s and 1970s, and the Great Lakes habitat crisis of today.

This ecosystem faced an enormous pollution challenge just over 25 years ago. The Great Lakes system was over-enriched by phosphorus, tainted by chemical poisons. Lake Erie was declared dead, and our fish were full of acronyms that alarmed the public and menaced public health.

What was our response? We can learn from that response today:

- We spent money wisely and well. We taxed ourselves. On both sides of the border we invested more than $10 billion U.S. in wastewater treatment and other control programs. We were willing to pay the price to clean up our mess.
- We banned and severely restricted harmful substances. Now, mark those words. I didn't say we "studied" those substances. I didn't say, we "conferenced" on those substances. I said we acted to control those substances. My own state of Michigan: set tough phosphorus limits before the rest of the states, was among the first to ban PCBs and DDT, and vigorously attacked mercury poisoning.

What are the results? As Barry Commoner has pointed out, our greatest environmental successes since 1970 have resulted from bans or severe restrictions. Levels of the most threatening pollutants we identified then have fallen 70 to 90%. There are still health concerns, but they are far less serious than they would have been.

There are other lessons we can learn:

- We didn't always wait for final proof before acting. Take a look at the attack on lead. Recent research suggests it's a health issue at levels far below what we thought was a problem 25 years ago, damaging children for life. We were right to go ahead.
- It was the professionals who first detected, and then called for action. Everybody today points to "gross" pollution as the basis for quick public action in the early 1970s. But nobody could see or hear PCBs or DDT, and few could see their effects. Scientists - concerned professionals - clanged that alarm bell.

Permit me a moment of speculation. What if we had approached the pollution crisis the way we have so far approached the habitat crisis?

We might still be using the municipal equivalent of outhouses. Consider the amount of money we invest today in habitat; it is pennies on the dollar when measured against the need. In Michigan, we've reduced field staff who protect wetlands, rivers, and nearshore habitats, never funded habitat mapping, and generally treated habitat as a budget stepchild. Our Natural Resources Trust Fund rarely purchases habitat for habitat's sake.

We might still be dosing ourselves with PCBs, DDT, chlordane and other chemicals. Instead of acting on the precautionary principle, we would have encouraged PCB and DDT reduction and appealed to the stewardship ethic of polluters. We would have given gold stars to those who cooperated, but rarely sanctioned those who didn't. We would have brought experts together for five, 10 or 15 years before we developed the Great Lakes Water Quality Agreement, which is celebrating its 25th year of accomplishment in 1997.

Most importantly, we would have ignored, overridden, transferred or fired the professionals who gave us the bad news. That's what's happening today in Michigan and, I suspect, in other venues.

We must learn from the pollution crisis to face the habitat crisis. We must hear from the professionals at gatherings like this. Your voice must be clear, consistent, and urgent. And it must be fearless. We need a clear and consistent message like any campaign, and that message must be: a healthy Great Lakes system cannot be sustained with current habitat loss trends.

We must speak to the dangers of losing the character of our region, and set goals to assure that character is protected.

We must learn to say "no". We didn't say "maybe" to DDT and PCBs. We didn't pass a law banning them and then allow a multitude of individual exceptions and waivers, but that's what we do with wetlands, rivers, and nearshore habitats. We nibble them to death with our exceptions and waivers.

We must fight for the resources to do the job right. It is appalling that we could spend billions on sewage control and pennies on habitat. We need public funds to identify habitat and manage, protect and even purchase it.

We must advance the educational effort. Here is where my analogy to the pollution crisis is imperfect. It's one thing to spend tax dollars to build better toilets. That doesn't require a lifestyle change. But protecting and restoring habitat means telling people they have to adjust, shift, even sacrifice. It means we must learn to live in harmony with that habitat.

We must be positive. We must set a vision and communicate it. Whether it's the habitat equivalent of the Water Quality Agreement or something else, we need a rallying point for the public.

That's why I am supporting a Habitat Protection Initiative through the Great Lakes Fishery Commission. I am hopeful that over the next year, this Initiative will begin the process of educating and rallying the professionals and the public to protect our habitat, our living home.

I am proud of the leaders who preceded us in the 1960s and 1970s. They had the vision; they acted. I feel our task is no less urgent. At the end of our day, the question will be; did we rise to the challenge as they did? Did the Great Lakes system decline while we slept, or did it recover because we acted? Did

we show the courage, as residents and professionals among the greatest lakes in the world, to fight for habitat, and for what's right for current and future generations?

I. Managing and Understanding Habitat

Using Science for Fish Habitat Management
Charles K. Minns, Fisheries and Oceans Canada

Science has an important role in the management of fish habitat. All ecosystem management is experimental and success or failure should be measured using science. In Canada, quantification is the key to effective use of the Fisheries Act and the Habitat Policy. Now, net loss of habitat and productivity is on-going and existing science is often ignored or forgotten. Many unsolved questions exist, but habitat science is expanding.

At Fisheries and Oceans in Burlington, we are working on a range of projects, basic and applied:

1. Fish habitat assessment. Extensive studies of Great Lakes littoral habitats are aimed at developing means of predicting fish community attributes from habitat variables. This creates building blocks for management tools.
2. Population modelling. Multi-life stage models are being constructed with explicit representation of the density-dependent effects of limited suitable habitat supplies. Using these models, objective means of identifying 'critical' habitats are obtained.
3. Net change equations. A mathematical framework for measuring net gain or loss and 'harmful alteration, disruption and destruction' provides a quantitative basis for policy implementation.
4. Defensible Methods. A practical, scientifically defensible software tool for assessing development and restoration projects affecting fish habitats is being developed. This will lead to reduced agency workloads and more of the assessment onus being shifted onto proponents.
5. Fish habitat management plans. Quantitative, GIS tools for conserving and protecting habitats and fish biodiversity and productivity in large areas will provide the contexts for managing development in ecosystems.

These habitat science projects are producing the basis for improved management. However, not all the questions can, or will, be answered and sound decision-making should begin with application of the 'precautionary principle'. Better science and stronger management will lead to a steady net gain of self-sustaining productive fish habitat.

Land by the Lakes

Karen Holland, U. S. Environmental Protection Agency

The health of the land by the lakes, nearshore terrestrial ecosystems, is degrading throughout the Great Lakes. In reaching this conclusion, the authors of the *Land by the Lakes* paper developed for the 1996 State of the Lakes Ecosystem Conference in Windsor, Ontario, presented information about negative and positive human impacts to the shoreline. The nearshore terrestrial environment was viewed from three perspectives: the 17 ecoregions within the Great Lakes basin, the 12 special ecological communities along the lakeshore (sand beaches, sand dunes, bedrock and cobble beaches, unconsolidated shore bluffs, coastal gneissic rocklands, limestone cliffs and talus slopes, lakeplain prairies, sand barrens, arctic-alpine disjunct communities, Atlantic coastal plain communities, shoreline alvars, and islands), and the status of individual lakes. A letter grade from "A" through "F" indicated the quality of the shorelines of the ecoregions and the special ecological communities, whereas as a scale from "good" to "poor" characterized four elements regarding the status of individual lakes.

For purposes of the *Land by the Lakes* paper, ecoregions are large landscape areas defined by climate, physical characteristics, and the plants and animals living there. The extent to which special ecological communities are represented and protected within 17 ecoregions, and the rate of land-use change affecting these communities, determined the ecoregion rating.

Within each ecoregion, at least half of the shorelines suffer from moderate degradation. Strategies for managing these ecoregions should include protection of representative areas containing the full range of nearshore biodiversity within parks or protected areas or through voluntary programs. Only a few of the ecoregions are fully represented now; over half have seriously inadequate representation, with a trend of moderate to severe degradation of shoreline health.

Because of the varying nature of the ecoregions and their relationship to the Great Lakes, this approach to assessing the quality of shorelines works better in some regions than others. In the ecoregions along the north shore of Lake Superior, for example, land uses and stresses are fairly consistent across the coastal areas of each ecoregion. But in some of the more southerly ecoregions, particulary those which front on more than one of the lakes, this degree of generalization may mask important internal differences.

For purposes of the *Land by the Lakes* paper, special lakeshore ecological communities are places having unique physical features and habitats supporting biodiversity or unique plant and animal life. The quality of 12 special lakeshore ecological communities was rated by the authors of *Land by the Lakes* on the basis of percentage of the community remaining in a healthy state, major stresses, sources of stress, process/functions impaired, species/communities endangered/threatened, stewardship activities in place, and the trend from no change to severely degrading. Although most of these community types are undergoing some conservation activities, eight of the communities (sand beach, sand dune, bedrock/cobble beaches, unconsolidated shore bluffs, coastal gneissic rocklands, sand barrens, Atlantic coastal plain communities, and islands) are considered to be moderately or severely degrading. Shoreline alvars and lakeplain prairie communities are most at risk.

Each lake was also assessed according to four indicators: loss of communities/species, interruption of shoreline processes by lake-edge armouring, representation of biodiversity in lakeshore parks and protected areas, and gains in habitat protection in selected "biodiversity investment" areas. With several exceptions, Lakes Huron, Michigan, Erie, and Ontario are rated in the mixed/deteriorating or the poor category. Lake Superior receives a good rating in almost all categories.

Given the findings that existing protection and restoration programs are inadequate to meet the continuing stresses to habitat and physical processes, a conservation strategy for Great Lakes coastal areas is urgently needed. This strategy should seek to involve all levels of governments and other stakeholders, reflect commitments to biodiversity conservation and sustainable development, and secure broad support from Great Lakes citizens. It should place special emphasis on protecting large core areas of shoreline habitat within 19 Biodiversity Investment Areas. The Biodiversity Investment

Areas are clusters of shoreline areas with exceptional biodiversity values that present key opportunities to create large protected areas that will preserve ecological integrity and, ultimately, help protect the health of the Great Lakes themselves.

Incidental Habitat at Great Lakes Navigation Structures

Phil Moy, U.S. Army Corps of Engineers

Great Lakes navigation structures form aquatic habitat merely by their presence in the water. The hard surfaces, protected crevices, calm waters, and physical presence diversify the near-shore open lake habitat and provide attachment surfaces for periphyton and invertebrates as well as cover and protected habitat for forage and young-of-the-year fishes. These structures provide nearshore species with a navigation reference and are attractive to both anglers and fish.

Though these structures are built to withstand the forces of ice and breaking waves, to calm waters in a harbour, or to protect shorelines from erosion, certain features can be modified t/ enhance their value for anglers, fish and aquatic wildlife. The extent of modification that is possible depends upon the location and purpose of the existing feature. When considering a modification for habitat, resource managers must bear in mind that the primary purpose of the structure is navigation safety and that habitat enhancement must not adversely affect that purpose. Aquatic habitat modifications can include slight changes in rock sizes at the base of the structure; improvements at the crest for angler or pedestrian access or other possibilities.

There are essentially three types of construction used for navigation and shore protection structures on the Great Lakes: rubble mound, steel sheet pile and timber cribs. Shore protection revetments and breakwaters have similar designs, revetments are essentially "half" of a breakwater.

Steel sheet pile structures can offer a flat walking surface and easier pedestrian access to the water surface but have flat, relatively featureless walls below the water surface. These structures have scour stone at the base to prevent erosion by waves. There should be some flexibility in the size of the scour stone for habitat enhancement. During new construction, the invaginations of steel sheet pile walls may be augmented below the deepest vessel draft by adding projections or cover attached to the walls.

Timber crib breakwaters are formed by filling wooden cribs with rock or other fill material. The wood tends to rot near the water surface such that the structural integrity is lost. For this reason, many timber crib structures have been encapsulated with rubble or steel sheet pile. Timber crib structures have scour stone at the base and a flat timber wall extending to the water surface. The timbers provide woody habitat and interstices for invertebrates and forage fish, though cover for larger predators may not be as plentiful as at a rubble mound structure.

Rubble mound structures are comprised of layers of stone. The largest, wave breaking stone is on the surface, it is supported by layers of smaller stone sizes underne! th. Generally, the size of the largest stone, the ones visible at the water surface, cannot be altered. The small interior (mattress or core) stone is visible at the base of the structure, extending out from the base of the break wall at a relatively flat slope. The size (and interstitial space) of the smaller stone can be altered to enhance spawning or foraging habitat.

New construction and maintenance of existing structures are opportunities to incorporate habitat and access features at navigation structures. New construction can provide greater flexibility in design than maintenance of an existing structure. Contact the U.S. Army Corps of Engineers or Canadian Coast Guard to find out if any maintenance work or new construction is planned. Seek to improve angler access by improving walking surfaces, make piers handicapped accessible, and investigate ways to improve aquatic habitat such as spawning, cover and foraging habitat. Open and ongoing communication is key to enhancing habitat at navigation structures. It is critical to get habitat features into the project planning and design process at an early stage. Habitat modifications such as a change in stone size can be incorporated at no cost if added early during the design phase. Changes in material type or dimension have to be incorporated into plans which may be prepared a year or more in advance. Once construction equipment is on site, habitat proposals are generally unwelcome. Access or habitat modifications which increase the cost of construction may require payment by a local sponsor. The Corps of Engineers has cost-sharing programs for some modifications. Be prepared to compromise on the proposed habitat feature and follow up on the suggestion to be certain that it is included in the final design and is not lost in subsequent design phases. Finally, monitor the resulting structure and report the success or failure of the habitat change so that others may learn from the experience.

Large River Ecosystem Unit

John Seyler, Ontario Ministry of Natural Resources

The Large River Ecosystem Unit (LREU) was established to collect, analyze and distribute information about physical, chemical and biological aspects of northeastern Ontario's river systems. The geographic focus of many of the scientific studies being undertaken by the LREU is the Moose River Basin, one of the most fragmented river basins in the world. Providing science for aquatic habitat management is a priority for the Unit. The LREU provides opportunities for government, industry and stakeholders to work collaboratively towards the acquisition of river science. The Unit has several habitat focused initiatives underway.

The LREU is currently developing a river information management system (RIMS) which will store existing information on northeastern Ontario's river systems in a georeferenced format. RIMS operates from a Windows based menu system and is driven by GIS software which allows users to query and examine information spatially. RIMS incorporates information in the form of maps, charts, text, video and photographic media. RIMS contains information in formats which can be directly used in hydrologic, hydraulic and habitat modelling simulations and provides the means of presenting model outputs.

Many planning processes occur on a watershed scale. One of the goals of the LREU is to link processes at the reach/mesohabitat scale to geoclimatic features that occur within tertiary and quaternary watersheds. A watershed classification system is being developed to identify similarities between landscape units. Thematic layers of information describing the geology, climate and hydrology of the Basin will be overlaid to determine which variables collectively define 'classes' of watersheds.

The LREU is working towards the development of a regional fish habitat utilization data base and habitat suitability relationships. To date, work has focused on juvenile and adult lake sturgeon (*Acipenser fulvescens*) which represent a significant component of fish communities throughout the Basin. Relationships between fish and physical conditions at micro- and mesohabitat scales is poorly understood which in turn limits the ability of managers to provide meaningful input to water management operating plans.

Several of the hydroelectric facilities in the Basin operate as peaking operations, supplying power only during peak demand periods. Physical conditions below peaking stations fluctuate significantly over 24 hour, weekly and seasonal operating cycles. The LREU is conducting a study to describe

longitudinal changes in macroinvertebrate communities and physical conditions below a peaking facility on the Abitibi River. This study also provides an opportunity to work on the development of habitat based invertebrate sampling protocols.

Design Diversification for Sea Lamprey Barriers

Tom McAuley, Sea Lamprey Control Centre

Instream barriers provide a cost-effective non-chemical method for the control of sea lamprey in Great Lakes tributaries. They constitute an important vehicle towards the Great Lakes Fishery Commission's goal of a 50% reduction in lampricide use. To help reach that goal, ongoing technology development in the barrier program is producing a diversification of barrier types that can be fitted to particular stream and site conditions and various fish migrations. The principal types of sea lamprey barriers are summarized below.

Fixed-crest barriers with hydraulic heads of less than one metre have constituted the basic sea lamprey barrier option. These barriers have been developed and in use since 1978 and have been employed effectively on about 30 sea lamprey streams in the Great Lakes basin. They may be built of concrete, steel sheet piling or gabions, and usually have a built-in lamprey trap. Jumping salmonids are able to pass but not non-jumping fish.

A velocity barrier exploits differences in swimming ability between various migratory fish and sea lamprey. The barrier requires a surface material that prevents oral attachment by sea lamprey. Velocity barriers can be designed for various water velocity and length combinations, as long as these are beyond the swimming ability of sea lamprey. An experimental velocity barrier was constructed in 1993 on the McIntyre River at Thunder Bay. This barrier has an 8.5 m long chute with an average water velocity of about 2 m/s. Velocity barriers can be designed to pass non-jumping fish greater than approximately 35 cm in length.

Graduated-field electric barriers of the Smith-Root type have been installed since 1986-88 in three Michigan streams: the Pere Maruette River, the Jordan River and the Ocqueoc River. Work is underway to overcome problems with steelhead passage at the Pere Marquette barrier. At the Jordan River barrier, an improper band-width setting may have been the cause of lamprey passage over past years. The Ocqueoc barrier was operated for several years only.

Adjustable-crest barriers with automatic/remote control were designed and built in 1995 on the Big Carp River near Sault Ste. Marie and on Big Creek, a tributary to the north shore of Lake Erie. The hinged steel crest plates of these barriers are raised by pneumatic bladders during the spring lamprey migration. Fishpass channels are incorporated in these structures for passage of non-jumping fish in the period when the crest is raised. Trapping and sorting is required to remove sea lamprey while other fish are released upstream of the barrier. Pressure transducers and on-board control systems allow these barriers to automatically maintain a constant head or to be remotely controlled through a modem link to the Sault Ste. Marie office or a portable computer.

Using GIS to Address Habitat Concerns in the Lake Superior Basin

Mike Koutnik, ESRI (Environmental Systems Research Institute)

Overview

The context for this presentation was to inform the participants of a GIS project that has been funded by USEPA (granted to Minnesota DNR) in support of habitat objectives under the auspices of the Binational Program for the Restoration and Protection of the Lake Superior Basin (Binational Program). The project will use GIS to:

1. Further specific habitat objectives under the Binational Program
2. Assist in efforts toward long-term sustainability of habitat in the basin.

Background

The Binational Program specifically identifies habitat objectives under what is referred to as the "broader program." The broader program strives to attain a sustainable economy and ecology within the Lake Superior Basin. The Lake Superior Workgroup formed the Habitat Committee to work on habitat issues under the Binational Program. The Habitat Committee will provide advice and guidance for the proposed project. Further input will come through consultation with other groups and individuals concerned with habitat, including the Lake Superior Binational Forum, Lake Superior Ecosystem Cooperative, indigenous groups and researchers.

Project Context

The project design is based on the notion that resource use practices and patterns have a direct impact on habitat quality and quantity. By "resource" we primarily refer to land use, but water use and air use also are of concern. Next we assume that understanding the relationship between habitat quality and quantity and resource use will help us to understand trends in habitat, as well as how we can work toward long-term sustainability of habitat in the basin.

Evidence suggests that the Great Lakes basin collectively, and the Lake Superior Basin specifically, harbor a world-class level of biodiversity. Thus we are interested in assessing Lake Superior habitat as a whole. Using GIS we will be able to visualize patterns and analyze spatial and temporal trends that would be impossible, or at least impractical without it. Thus, GIS offers us the tools that can help us to gain a unique understanding of habitat and resource use issues. We recognize that habitat vis a vis land use is a complex subject, but we are hopeful that this project can increase our understanding of the major factors that operate at multiple scales in the basin.

Project Objectives and Tasks

The project will attempt to use GIS toward these goals:

1. Develop data (and potentially assessment tools) that can be used by researchers.
2. Develop prototype analysis tools that can be used by local land use policy makers and/or administrators.
3. Develop prototype management tools to be used by resource managers.
4. Develop educational programs for the public.

In order to reach these goals, we will need to take on the following tasks:

1. Develop seamless digital base maps for the entire basin.
2. Map important habitat locations.
3. Map critical impacts on habitat.
4. Analyze trends of habitat and their impacts.
5. Project trends in habitat and their impacts.
6. Develop prototype resource policy and/or resource management applications.
7. Develop interpretive GIS visualization applications for public education.

This project is highly dependent on previously developed data, standards, research knowledge and local experience. Our intent is to leverage these resources as best as we can and to develop relationships with organizations and individuals who have an interest in the project objectives or a need for its products.

Panel One: "Mitigation, Compensation and the Law - Why Are We Still Losing Habitat and How Can We Reverse This?"

Comments from Panel Members:
Ed DeBruyn, Canadian Department of Fisheries & Oceans

A brief overview of the Fisheries Act and the Policy for the Management of Fish Habitat (DFO, 1986) was provided for background information. The Fisheries Act and the Policy are implemented in Ontario through an Interim Referral process established through an agreement between DFO and Ontario Ministry of Natural Resources (Canada-Ontario Fisheries Agreement). The Interim Referral Process establishes a mechanism by which projects which have the potential to result in a harmful alteration, disruption or destruction of fish and fish habitat contrary to Section 35 (1) of the *Fisheries Act* are referred to DFO in Ontario for consideration of authorization pursuant to Section 35(2) of the *Fisheries Act.*

An authorization pursuant to Section 35(2) or 32 of the *Fisheries Act* is a 'trigger' under the *Canadian Environmental Assessment Act* (January 1995). This means that before an authorization can be issued, the project must be reviewed to ensure that the environmental impacts on areas of federal responsibility are not likely significant with the appropriate mitigation. (Mitigation as defined in the Canadian Environmental Assessment Act includes compensation whereas in the Policy for the Management of Fish Habitat, mitigation and compensation are separately defined). Areas of federal responsibility generally include transboundary waters, migratory birds, navigable waters, fish habitat and aboriginal peoples.

The determination of whether projects would be authorized or not was based on the nature of the project and how that project would impact on fish and fish habitat. A DFO Policy Directive provides a context in which to review projects which have the potential to result in a harmful alteration, disruption or destruction of fish and fish habitat. The habitat at risk must contribute directly or indirectly to a commercial, recreational or subsistence fishery or have the potential to contribute. Authorizations for harmful alteration, disruption or destruction of fish and fish habitat are only issued in those cases where the habitat lost is acceptable and the habitat loss is compensated for in an acceptable manner. Preferences for compensation are like for like on or near site or like for like off site. Consideration can be given for dissimilar compensation off site (eg. wetland creation for lost creek channel habitat). Determination of appropriate mitigation measures and compensation for projects resulting in a harmful alteration, disruption or destruction of fish and fish habitat is often site or case specific.

Categories of projects were given as examples where authorizations could be issued because known techniques were available for compensation such as shoreline protection, creek channelization, small hydro projects, marinas. Other examples were given where authorization was more complex because compensation options were not known such as whole lake destruction and habitat transfer (eg. riverine to lacustrine or cold water stream to warm water stream).

There is still a need to develop a consistent approach to determining the productive capacity of any given fish habitat in order to make defensible decisions on the acceptability of habitat loss and the compensation proposed and accepted. There are also some policy needs on how to address issues like whole lake destruction (mine tailings areas) and riverine to lacustrine conversions (large hydro reservoirs).

Kent Gilges, The Nature Conservancy

Why are we still losing habitat?

There is a lack of public support for government conservation of wetlands and other habitat. The involvement of multiple agencies (DNR, USACOE, USFWS) makes the process unworkable. Agencies are perceived to be inflexible and/or untimely. It often takes 2 - 3 years for permits to be issued. There is the perception that "money talks", that is, rich people get permits while local people get the runaround. There is also the general perception that the laws don't really protect habitat. For example, laws may be applied to a one acre tract surrounded by parking lots where development should take place, while other places that local people value are lost. Looking at the broader picture, agencies do not have a good plan to protect habitat; instead they just follow the letter of the law. There is a basic lack of public understanding about how government regulation protects habitat.

It is interesting to note, however, that over 87% of people in one Upper Peninsula township support protection of the natural beauty and values of their environment. It seems that people oppose government intervention, not habitat protection. In general, people understand their environment and how various habitats affect things they value like wildlife populations.

Habitat is also being lost because there is a lack of government will to enforce laws. Agencies go out of their way to accommodate landowners and avoid confrontation. Top levels of state government want to scuttle regulations or cut money for enforcement. Everyone is overwhelmed by the volume of paperwork.

What can we do?

Regulations concerning land development have to be more transparent and easier for the public to understand. One proactive approach would be to develop "County Habitat Conservation Plans". Agencies should work with local units to develop detailed land use maps that describe protected and unprotected habitat, wetlands and other designations so that any landowner knows prior to buying the land that (s)he can or cannot build on the parcel. Protected areas should be viable. An area which will have no habitat value in the long-term (>50 years) should not be protected. Maps should be available

locally and should be hammered out by stakeholders (not developed by agencies in isolation). Landowners need assurance that habitat targets and designated areas will not change over time. If stakeholders are involved in the process to designate and protect important habitat, they need to know that areas which are designated for development can, in fact, be developed in the future.

Local groups, including non-profit groups, civic organizations and local government, should be used to build bridges to local communities and bring together stakeholder groups. Government agencies are not the right conduit for success.

Ed Iwachewski, Ontario Ministry of Natural Resources, Lake Superior Programs Office

As biologists, we are on the front line for habitat protection and restoration efforts. Often it feels like we are the only ones out there, although our agencies may claim to stand behind us. Many times we are faced with situations where we are outgunned or simply overruled in decisions which we may believe are not in the best interests of habitat at a given site or on a broader scale. We are constantly losing important aquatic and terrestrial habitat. But there are a number of things we can do to at least give us better odds of succeeding in achieving "no net loss" or, saints be praised, net gain. Many of these begin with the letter "c".

The first is Compromise. The word compromise is one we are all familiar with. People tell us, "I'm sure we can reach a reasonable compromise." This generally means that we surrender our position and give in to their demands. Thus compromise is often considered by many of us to equate to a "Policy of Appeasement", and has many negative connotations. Compromise can lead to what we call "slow net loss" or worse, but it is important, and I'll get back to it.

The next issue is Continuity. Part of the reality of our profession is that we change jobs and work locations, either to gain new experience, for a promotion or more recently because of cutbacks, because we are forced to go. In any case, this means that the knowledge you have of specific sites or projects can be lost or not considered after you leave. There may not even be a replacement for you. I recall a subdivision proposal that we fought on the grounds that there were a number of cold-water springs that rose out of the site and provided critical brook trout microhabitat during the hot weather and low flows of mid and late summer. I moved on to another job, the other person working with me was let go, and the subdivision went ahead with no mitigation for our concerns. This was despite extensive documentation we had done to support our position. A good strategy for project proponents is simply to wait for the bureaucracy to be shuffled and then push ahead with their proposal. They usually don't have to wait too long. We need to leave behind a highlight film or something that ensures there will be some continuity and awareness in protecting habitat.

The third item is Competence. We have an obligation to be the best that we can be. We have to know the literature, the current literature. We have to understand it and be able to explain it to proponents and our senior managers. The same with the pertinent legislation and policy. Our position is undermined when we cannot provide strong, rational arguments and options. We also need to learn the language of our engineers, developers and industries, so we can speak competently about how their activities and operations can impact habitat, how they can be mitigated, or how they cannot be mitigated or compensated. We must also be willing to call for help, to be aware of others who have experience in habitat and can give us some insight and support. We are fighting for a common cause and need to help each other. Conversely, don't fight for the wrong thing. We are usually overworked (some might suggest underpaid too!) but we need to focus our efforts on the most important projects with the greatest potential for harm. Otherwise we will be overwhelmed by all the ongoing problems we face.

This brings us back to Compromise. The majority of successful habitat protection and restoration projects that I have been involved with would never have gone ahead without some degree of compromise. It is necessary to demonstrate success on a small scale before thinking we can get people to do things right on bigger projects. On one project we wanted to use vegetation to stabilize a degraded creek mouth and the municipality wanted to use concrete and rip-rap. We compromised on rock-filled gabion mats that have allowed natural vegetation to grow through, and we demonstrated the lower cost and structural integrity of vegetation to stabilize small sections of another stream. On the next major project, we were then able to convince the municipal engineers to save a natural portion of river bank from sheet steel piling and cut the cost of a $1 million riverfront enhancement effort in half. Small compromises can work for you if you think ahead to a bigger goal.

Lastly, we need Confidence. This comes from developing our competence, experience and support base so that we know when and where to draw the line and be prepared to defend it. Good luck in your battles but remember we are fighting a war.

Discussion

Public involvement requires public understanding of the process going on behind the Fisheries Act (Canadian) and other legislation-based discussions. In general, there is no easy way for the public to participate, although there have been cases where the public might have been able to sway a decision, if they had been involved.

- Local people and resources can be involved to cover field work situations, for example, to provide follow-up on decisions. It is important to provide local capacity like a volunteer or naturalist group, which maintains continuity in the community long after the government workers are no longer involved.
- Often people may hinder the process by following up on vested interests. People are generally more interested in protecting their neighbours property or habitat than their own. People have a very narrow focus about what they can do on their own property, and a broad focus on what everyone else should do. They often join groups to influence other people's activities. For example, members of a fishing club take exception to horseback riders riding through a stream.
- It is often difficult to get the public involved because they distrust government and believe that government is not acting in their best interest. It is difficult to explain to the public that what they may propose or want to do may be harmful to habitat. We haven't helped the public understand how important habitat is. The average tax payer supports the point of view that development is economically the best thing.
- Agencies can't build a sense of trust. One approach used by Kent Gilges is the "1000 cups of coffee approach to conservation" . This means sitting down and talking on an informal basis to a variety of people in the community. The role of government agencies is to identify and provide support for appropriate NGO's who carry out the grassroots work.
- Habitat managers have created a situation where there is a problem with public trust by establishing the "no net loss" policy. However, it is dishonest to claim that there is "no net loss". We are in the situation of managing the loss since we are still losing habitat. Therefore the question should be what is the rate of loss and what trade-offs are we willing to accept.
- The role of agencies is to transfer knowledge to local levels where it may be useful. Habitat loss begins at the zoning board of municipal governments. Therefore, the goal and concept of no net loss needs to be conveyed at this point. Unfortunately, it's the municipalities that decide where people are going to live and the DFO finds out after the fact. It is important to talk to city planners, developers, and strengthen the knowledge of people at that level.

- The goal of "no net loss of wetlands" is a good goal, as such. But it has not been achieved. However, the program/goal has been useful. Lots of impacts were minimized, some loss had to be compensated in consultation with agency representatives.
- We need to advocate a gain in habitat, not "no net loss". If a development is permitted, the role of government is to recommend how it should be done.
- The question remains, how can authority be maintained while building up a situation of trust. It may be possible to take the good cop/bad cop approach - "if you don't carry out these mitigative measures, then the regulations will kick in". Someone has to play the middle ground between the developer and agency but it is necessary to have regulations like a hammer in the background.

II. Developing Principles for Setting Goals, Objectives and Indicators

Towards a Basin-wide Set of Indicators - SOLEC '98
Harvey Shear, Environment Canada

What is the intent behind the series of meetings called SOLEC (State of the Lakes Ecosystem Conference)? These meetings fulfil the reporting requirements set out under the Articles of the Great Lakes Water Quality Agreement (GLWQA). They are also an opportunity to inform decision makers from around the Great Lakes and develop an information system on which decisions can be made. They provide a chance for agency staff working on Great Lakes habitat and water quality issues to meet and develop a basin-wide network of professionals.

The SOLEC series started in 1994 with a number of "State of the Lake" reports on toxic chemicals, nutrients, aquatic community health, human health, the economy, and habitat. A number of indicators were proposed as a means of monitoring progress in each of these subject areas.

SOLEC '96 reported on the state of the nearshore area as broken down into the different geographical zones of nearshore waters, coastal wetlands, and nearshore terrestrial. Other topics at the meeting were 'land use as a stressor' and 'the state of information management'. Again, there were sessions dealing with objective and indicator development.

Where does SOLEC '98 fit into the host of initiatives to develop indicators which are currently underway? These initiatives include Lakewide Management Planning (LaMPs), the IJC Indicators Task Force, activities by the Great Lakes Fishery Commission (GLFC) and various local initiatives on either side of the border. SOLEC '98 will focus on the development of a common base of indicators on which all parties can report progress and which provide an agreed 'end point' or desired level of achievement. SOLEC is the only forum where all the various players can work together and it presents the widest geographical scale of assessment. SOLEC will build on the work which has been put into the LaMPs and programs carried out by the GLFC and IJC. One objective of the upcoming meeting will be to present a balanced picture of all the stressors on the system, not just the chemical stressors. SOLEC will continue to present "weight of evidence" arguments for habitat protection.

Finally, SOLEC should be viewed as a process not a discrete set of meetings. It should be one of the drivers pushing for change in programs around the Great Lakes. Developing a set of indicators will help us to measure ecological and socio-economic effects resulting from human-induced environmental degradation and provide the basis for a response to end that degradation.

The Remedial Action Plan (RAP) Process as a Model for Addressing Habitat Issues

Ken Cullis, Ontario Ministry of Natural Resources, Lake Superior Programs Office

The RAP process can be viewed as a successful model for addressing a variety of aquatic and terrestrial habitat issues within the Great Lakes. This process, which has been a true partnership between government agencies and local communities, has provided the framework to identify specific habitat problems within Areas of Concern (AOC) and achieve many habitat restoration targets. Combining expertise and resources through the RAP process has provided the opportunity to demonstrate current habitat restoration technology and complete large scale habitat projects that could not be addressed by single agencies or organizations.

Drawing on the RAP experience in Lake Superior, there are four key aspects which have contributed to success:

1. **Clear Objectives.** There must be clear objectives in place which are compatible at all levels of regulation and involvement. For example, the Great Lakes Water Quality Agreement (IJC 1987) establishes water quality objectives for the Great Lakes. The RAP process specifically addressed any impairments to an established list of 14 beneficial uses. Within the bounds of the above two objective structures, the Public Advisory Committee (PAC) in Nipigon set Water Use Goals which pertained to the particular situation in their community.
2. **Inter-agency approach**. The Lake Superior Programs Office, which brings together 4 government agencies under one roof, provides coordination for the RAP projects on Lake Superior. It is a demonstration of how federal and provincial agencies, in times of severe financial constraint, can effectively share resources and expertise to reduce program costs, minimize overlapping mandates on environmental issues affecting Lake Superior and develop real partnerships with industry and the public.
3. **Funding source.** For many of the Lake Superior programs, the Great Lakes 2000 Cleanup Fund provided base funding. The objective of this Fund was to develop, demonstrate and implement cleanup technologies and techniques in the Great Lakes. The Cleanup Fund provided monies for up to one third of the proposed cost of the project and the remainder was covered by other partners who contributed both funding and in-kind support. Having one established funding source generally provides a catalyst for securing other funding partners.
4. **Community Involvement.** When members of the community are involved with developing and implementing a plan, they will share accountability for the project. On Lake Superior, strong support has been fostered through local Public Advisory Committees. These committees are true advisory groups which have assisted in project planning and implementation. All proposed projects were first approved by the local PAC before being considered by the Cleanup Fund for funding support. This process resulted in strong community partners during implementation and a community structure which was accountable for projects and could feel ownership for the successes which were achieved.

There are many examples in Lake Superior of how well the process has worked. The Clearwater Creek project in Nipigon, for example, was initiated by the Nipigon PAC. Agency participation and support was facilitated through involvement of staff from the Lake Superior Programs Office. The goal of the project was to completely rehabilitate Clearwater Creek which drains one third of the stormwater through the town and whose spring-fed waters once supported a healthy coaster brook trout population. The PAC developed a detailed 13-component plan for rehabilitation from the source to the mouth of the creek near the marina. Base funding was provided by the Cleanup Fund which drew in over 15 other partners who contributed additional funding and in-kind support. Community involvement was successfully encouraged by holding a number of cleanup events and incorporating stream projects into the curriculum of a nearby school.

Reference

International Joint Commission. 1987. Great Lakes Water Quality Agreement of 1978 as amended by Protocol signed November 18, 1987. Consolidated by the International Joint Commission, United States and Canada. Windsor, Ontario. 130 pp.

A Framework For Guiding Habitat Rehabilitation In Great Lakes Areas Of Concern

Brian McHattie, Environment Canada

Plans designed to restore fish and wildlife habitat are being implemented in Areas of Concern (AOCs) across the Great Lakes basin. The ultimate goal of this work is to delist the AOC, or in other words, to restore the area to the point it can be considered 'cleaned up'. The framework described here provides targets or end points to guide planning teams in an attempt to answer the difficult question of 'how much habitat is enough?' (Table 1). This information has been developed through a comprehensive review of the literature and is based on an understanding of how much habitat is required to provide for the ecological needs of fish and wildlife species.

Table 1: Habitat Rehabilitation Targets Developed for Areas of Concern

Parameter	Target	Rationale
Percent forest cover in watershed	>30%	will support most bird species expected within range
Size of largest forest patch (minimum 500 m wide)	Minimum of 100 ha	will support most area-sensitive bird species within range
Per cent of watershed that is forest cover 100 m or farther from edge of patch	>10%	will support most forest interior and edge bird species within range
Per cent of watershed that is forest cover 200 m or farther from edge of patch	>5%	will support most forest interior bird species within range
Per cent natural vegetation along first to third order streams	75% should be naturally vegetated with 30 m wide buffers	maintain water temperature, stream bank and channel integrity, removes excessive sediments and nutrients
Per cent baseflow of average annual flow	>25%	capable of supporting a self-sustaining coldwater fishery
Total suspended solids concentrations	<25 mg/l	no harmful effects on fish or fish habitat
Stream sinuosity	Meander every 5 to 7 bankfull channel widths	stable channel with optimum pool to riffle ratio
Per cent wetlands in watershed	10% of total watershed or to restore to the original extent of wetlands	raises base flow and reduces flood peaks; reduces sediment and nutrient loads
Per cent wetlands in sub-watersheds	6% of each sub-watershed or to restore to the original extent of wetlands	as above
Amount of vegetation adjacent to wetland	Wetlands should have 240 m of adjacent upland habitat	optimum habitat for wildlife species dependent on both wetland and upland areas

Additional categories of habitat such as grassland, alvar, lake habitat and others warrant further investigation. The targets serve as guidance only, and the definition of site specific AOC goals will be necessary. The information is most relevant to southern Ontario-like landscapes that are dominated by agricultural and urban land uses. It should be noted that these targets and thresholds are to be considered minimum requirements. Therefore, AOC watersheds or other land units that contain higher amounts of habitat than is outlined here (i.e. 35% forest cover or 15% wetlands) should maintain or improve that habitat.

The Severn Sound - Hogg Creek Test Case

Severn Sound, identified as one of 17 AOCs found on the Canadian side of the Great Lakes, is a 127 km^2 body of water in the extreme southwest corner of Georgian Bay. There are seven major watercourses that drain into Severn Sound. Hogg Creek, a permanent stream measuring 43.4 km in length, with a drainage area of approximately 65.4 km^2, has been selected as one of the pilot watersheds for testing the habitat targets because it is generally representative of conditions found throughout most of Severn Sound.

Using air photos, NTS topographic mapping, and Ontario Base mapping, a geographic information system (GIS) database has been constructed which has allowed for habitat conditions in the Hogg Creek watershed to be mapped and then compared against suggested forest and several of the riparian targets (Table 2).

Table 2: Comparison of the Hogg Creek Watershed to the Forest and Riparian Targets

Target	Hogg Creek
>30% Forest Cover	28.9%
Size of Largest Patch = >100 ha	163 ha
10% Forest >100 m from Edge	10.1%
5% Forest >200 m from Edge	1.8%
75% Vegetated Streams	49.7%
75% Streams with 30m Buffers	48.5%

The Hogg Creek watershed meets targets for per cent forest cover, size of largest patch, and per cent forest >100 m from edge. Using Ontario Breeding Bird Atlas data (Cadman *et al.* 1987), the total number of birds found in the Hogg Creek watershed was determined, as well as the total number of forest interior birds. Although these data are already 10 years old, the Atlas data base provides the most comprehensive analysis of the status and distribution of

the province's avifauna ever carried out. Based on the status of forest cover in this watershed (28.8% versus the 30% target), we would assume that approximately 90% of the birds that would be expected to occur by virtue of their Ontario nesting range should be present, but that some forest interior birds would be absent relating to the lack of >200 m forest interior present (1.8% versus the 5% target). Of the 92 bird species known to occur in the watershed, 87.8% of the forest bird species have been recorded as breeders, comparing very favourably to the threshold of 90% of breeding birds one would expect to find in a watershed with just under 30% forest cover. Only nine of 17 forest interior bird species recorded for the area actually occur in the Hogg Creek watershed, in turn reflecting the insufficient amount of interior forest cover. Bird survey work will be conducted in the summer of 1997 to field check breeding bird:forest cover relationships.

The Severn Sound Remedial Action Plan (RAP) team has identified how much additional vegetation planting would be required to meet 100% of the suggested targets. Using GIS, several options have been developed which, if enacted, would lead to greatly increased interior forest habitat and vegetated riparian habitat in the Hogg Creek watershed. At present, landowners are being contacted in the priority areas to encourage participation in reforestation projects. The RAP Team sees this process as an important way to prioritize their habitat rehabilitation activities towards well-defined targets. This approach is now being expanded to the other five watersheds within the AOC. To obtain a copy of the Severn Sound - Hogg Creek report, please contact, Keith Sherman, Severn Sound RAP Coordinator, c/o Wye Marsh Wildlife Centre, P.O. Box 100, Midland, Ontario, L4R 4K6, Tel. (705) 526-7809.

Next Steps/Application to the Lake-wide Management Planning Process

The framework is also being field tested in Metro Toronto and Region, Hamilton Harbour, St. Lawrence River, Niagara River, St. Clair River, Thunder Bay and Bay of Quinte AOCs. The final report will include a section on data needs and geographic information system technologies as well as the ecological basis for the targets. The results of the field tests will be reviewed by the RAP Steering Committee and a final draft framework is expected to be produced in June, 1997.

It is likely that the targets developed for AOCs would be useful in watersheds and landscapes of importance to the Lakewide Management Planning process. Application of the targets lake-wide should be examined through pilot tests using geographic information system database technology.

Reference

Cadman, M.D., P.F.J. Eagles and F.M. Helleiner, 1987. Atlas of the Breeding Birds of Ontario. University of Waterloo Press, Waterloo. 617 pp.

Binational Objectives and Indicators for Developing Lake Superior Ecosystem Sustainability

Bob Kavetsky, U. S. Fish & Wildlife Service

Responding to citizen initiatives recognizing the importance and uniqueness of the Lake Superior basin, Canada, the United States, the province of Ontario and the states of Michigan, Minnesota and Wisconsin developed the *Binational Program to Restore and Protect the Lake Superior Basin* (Binational Program). One aim of the Binational Program is to develop and achieve the vision and goals contained in the document "Ecosystem Principles and Objectives for Lake Superior" which has been crafted and refined in response to comments received since early 1992. To measure progress toward achieving these Ecosystem Objectives, the Superior Work Group selected writing team leaders for each Objective (General, Aquatic Communities, Terrestrial Wildlife, Habitat, Human Health, and Developing Sustainability) in 1994. These teams have designed Indicators and Targets for each Objective. The Great Lakes Fishery Commission's Lake Superior Technical Committee produced the Indicators and Targets for Aquatic Communities, which mesh with their own fish community objectives. The presentation outlined the ongoing process for developing these documents, which serves as a model integrating economics, ecology and ethics on an ecosystem scale.

Lake Michigan Lakewide Management Plan

Stacy Greendlinger, U. S. Environmental Protection Agency

The Lake Michigan Lakewide Management Plan (LaMP) must be more than simply a document. The LaMP needs to be a continuous learning process that fosters dialogue and action among agencies and interest groups throughout the Lake Michigan basin.

The Lake Michigan LaMP will be ecosystem based. An ecosystem in flux requires the LaMP to be dynamic in nature, a concept which challenges environmental managers' traditional single-media, "command and control" mind set.

The goal of the Lake Michigan LaMP process is to create a useful, dynamic management tool. Natural resources will be managed by protecting and maintaining current resources and restoring resources which have been degraded. It is also the goal of the LaMP to foster relationships within the basin as well as a continuous information exchange and opportunities for learning.

The phases of LaMP development and the proposed timeline for completion are as follows:

Design Phase	January 1997
Research Phase	February - April 1997
Drafting and Formatting	April - August 1997
Review phase	August-December 1997
Public Comment Phase	December 1997

There are several challenges to be faced and overcome when developing the Lake Michigan LaMP. Thought must be given to managing the inherent incongruities in the Lake Michigan ecosystem, for example, the differences in natural features and ecosystem stressors in the north as compared to the south portion of the basin. It will require effort to maintain the dynamic nature of the LaMP in keeping with the original intent of this planning process. As well, truly embracing an ecosystem approach will be a challenge given the current state of knowledge and values.

The next steps for development of the Lake Michigan LaMP will involve information gathering from agencies around the basin, public meetings to gain information and input from interested individuals and groups, a process of gap assessments to determine where there are gaps in critical information, and an ongoing dialogue with USEPA and the Lake Michigan Technical Coordinating Committee, which is the committee of agency representatives responsible for LaMP development.

Fish Community Objectives for Lake Huron

Mark Ebener, Chippewa/Ottawa Treaty Fishery Management Authority (COTFMA)

Fish Community Objectives (FCO's) for Lake Huron were finalized by the Lake Huron Committee of the Great Lakes Fishery Commission in April 1995 (DesJardine *et al*. 1995). FCO's for Lake Huron are a statement of consensus among the Michigan Department of Natural Resources, Ontario Ministry of Natural Resources, and the Chippewa/Ottawa Treaty Fishery Management Authority that are intended to describe a desirable fish community bounded by certain ecological concepts and guiding principles. The FCO's set out whole-lake fish community objectives and further commit management agencies to the protection and restoration of the lake's fish community. The objectives are not always quantitative, but where they are quantitative, FCO's are expressed as fish yields, and the yields are viewed not as targets, but as an indication of fish community response to management actions.

The basic ecological concepts of FCO's for Lake Huron are stability, balance, and sustainability. Stability does not imply a steady state, but rather refers to the ability of the fish community to maintain its integrity. Integrity of the fish community implies that it can persist in the face of exotic invaders, resists change in the face of disturbance, and recovers quickly from disturbances. Balance refers to a state where the ratio of predators to prey allow a sustainable and efficient transfer of nutrients and energy up through the food chain. Sustainability embodies long-term, desirable outcomes from natural systems to meet the aspirations of society for today and tomorrow. Sustainability emphasizes the need to view the lake as a whole system and to recognize Lake Huron's productive limits.

FCO's for Lake Huron identify twelve guiding principles that will be used to guide formulation of management policies. Those guiding principles are:

- the lake must be managed as a whole ecosystem,
- preservation and restoration of habitat is foremost in the ecosystem approach,
- harvests from a healthy Lake Huron are limited,
- naturally reproducing communities of native and naturalized fish provide long-term benefits to society,
- exotic species already established must be viewed as parts of the community,
- stocked fish are essential for continuing progress in restoring biological integrity,
- rare and endangered species add to the richness of the community,
- species diversity contributes to balance and stability,
- genetic diversity is important to overall species fitness and adaptability,
- socio-economic values are a priority in decision making,
- fisheries are a priceless cultural heritage, and
- good management is based on the best available science tempered by society's needs.

FCO's for Lake Huron establish an overall goal and twelve objectives. The overall goal is to "*Over the next two decades, restore an ecologically balanced fish community dominated by top predators and consisting largely of self-sustaining indigenous and naturalized fish species capable of sustaining annual harvests of 8.9 million kg.*" The 8.9 million kg goal is the recorded harvest from Lake Huron between 1912 and 1940 and is considered the best measure of the long-term harvest potential under the current constraints imposed by the lake's morphometry and chemistry. The twelve objectives address groups of fishes, individual species, as well as habitat, genetic diversity, and species diversity. FCO's for Lake Huron address:

1. Salmonines (salmon and trout),
2. Percids (walleye and perch),
3. Esocids (northern pike and muskellunge),
4. Channel catfish,
5. Coregonines (whitefish and ciscoes),
6. Centrachids (bass and sunfishes),
7. Sturgeon,
8. Prey species (ciscoes, sculpins, lake herring, rainbow smelt, alewives),
9. Sea lamprey,
10. Species diversity,
11. Genetic diversity, and
12. Habitat.

Measures of achievement were also developed for Lake Huron as a way to evaluate progress at achieving FCO's. Measures of achievement principally include fish harvest levels and population abundance. Specific measures of achievement in the FCO's for Lake Huron include creel surveys, catch sampling, index netting, age and size structure, growth, mortality, sea lamprey marking, presence of rare or endangered species, and the number and presence of specific strains of fish.

Issues of concern that may prevent achievement of the FCO's are also outlined. Habitat alteration, sea lamprey, burbot abundance, and exotic species all currently limit achievement of FCO's in Lake Huron. The effects of exotic species like the zebra mussel, white perch, ruffe, and European cladoceran *Bythotrephes cederstroemi* remain unknown. In addition, agencies currently have only a limited understanding of the interactions among species in the lake.

Reference

DesJardine, R. L., T. K. Gorenflo, R. N. Payne, and J. D. Schrouder. 1995. Fish-community objectives for Lake Huron. Great Lakes Fishery Commission Special Publication 95-1.

Breakout Sessions on Developing Principles for Setting Goals, Objectives and Indicators

Objective: To identify key ideas and practical considerations for the development and implementation of habitat objectives.

Fish Community Objectives

Summary

There is a need when setting fish community objectives to move from "use"-based to ecosystem-based objectives and from qualitative objectives to those which are measurable and quantifiable. In many cases, enough information is known from which to set management objectives, but the actual choice of objective is affected by differences between jurisdictions in the information base available and the demands placed on the resource. Different jurisdictional structures and philosophy may not be an impediment to objective setting, but may affect implementation. There is a need to identify priorities and a timetable for implementation. In most cases, the responsibility is agency-based.

In order to resolve conflicts between Fish Community Objectives and broader Ecosystem Objectives (as developed through the Lakewide Management Planning process): 1) One set of objectives should be developed for each lake. 2) Communication between objective setting groups should be increased. 3) Effort is needed to identify areas of compatibility. 4) Wide representation in objective development is necessary. 5) An "endorsement" of ecosystem objectives is not enough. There is a need for agency commitment to ecosystem objectives, as has been given for fish community objectives.

Trends in Setting Fish Community Objectives

When setting fish community objectives, there needs to be a shift from qualitative objectives to more measurable, quantitative objectives. The amount of information about a particular parameter is one factor determining whether qualitative or quantitative objectives can be set. For example, there are many years of harvest data for lake trout which would assist in setting quantifiable targets.

There should also be a movement from 'use' based fish community objectives to 'ecosystem' based objectives. The goal is a balanced fish community which is sustained by natural reproduction. In a balanced community, predators are abundant enough to control prey oscillations and there should be no dramatic fluctuations within a species. A target predator/prey ratio may be set which is quantifiable and measurable. A comparison to "presettlement" conditions is often used as a guide for "full restoration", which provides an indication of what has been lost and sets the upper limit of the scale for achievable restoration goals.

There is a need to separate the concepts of potential yield from harvest yield as a basis on which to set objectives. Currently, some objectives are based on long-term yield rather than on pristine or "presettlement" conditions. In some cases, the objectives are driven by the demand from anglers or commercial fishermen, for example, with population levels of Lake Michigan chinook salmon.

Implementation Issues

One question which must be asked is, do we know enough about ecosystem function to manage the fisheries, especially considering the ongoing species introductions and losses? Participants felt that enough is known on which to base reasonable management, but that outside demands place constraints on which options are possible and which objectives may be established. The differences in the information base and the demands placed on the fish resource between different jurisdictions can affect the selection of objectives and indicators. For example, good measures of lake trout health are available on which to set objectives, but there are differences in exploitation of lake trout between different jurisdictions. Different jurisdictional structures and philosophy may not be an impediment to objective setting, but may affect implementation.

There is a need to identify priorities and a timetable for implementation. Milestones and assignment of responsibilities are necessary for accountability and credibility. In most cases, responsibility will be agency-based.

Moving away from crisis management through stocking to a self-sustaining situation may be expected to significantly reduce the costs of maintaining a fishery on a particular population. Not all costs are eliminated, though, since harvesting from a self-sustaining population also has high assessments costs associated with it in order to protect the fishery and the population. Advances in technology have increased harvests but necessitate higher management costs.

A key issue is the difference in the level of government commitment for various objectives. Fish Community objectives are supported by a "signed" agency commitment, whereas lakewide ecosystem objectives developed through the LaMP process are "endorsed" by different agencies and supported by a staff-level commitment. Within one organization, different managers may be responsible for Fish Community Objectives and Ecosystem Objectives.

Steps to resolving conflicts between Fish Community Objectives and Ecosystem Objectives

There was some conflict between the Fish Community Objectives and the Ecosystem Objectives for Lake Superior which were developed through the Lakewide Management Planning process. This conflict resulted from a failure to involve the Fishery Commission's Technical Committee in the early stages of the LaMP process when the ecosystem objectives were being developed. Fish Community Objectives had been developed prior to Ecosystem Objectives. Subsequent cooperative efforts to develop indicators and improved interaction between the Technical Committee and the LaMP program has overcome the initial difficulties.

It is clear that one set of objectives is needed for each Great Lake, including those for the aquatic community. Communication must be improved between groups setting objectives for the fish community and for the whole lake. Arriving at a common set of objectives should not be too difficult since most of the basic concepts, such as taking an ecosystem approach, are common to both sets of objectives. There must be wide representation when developing objectives and common ground must be found by identifying areas of compatibility, agreeing on those common points and working from there to resolve conflicts. It is also important that there be strong legislative support for both sets of objectives. It is not enough that agencies have "endorsed" lakewide Ecosystem Objectives. There must be the same commitment to Ecosystem Objectives as currently exists for the Fish Community Objectives.

Linking Aquatic and Terrestrial Ecosystems

Summary

Effective planning gets done at a local, watershed level, which is the level at which the general public and appropriate interest groups can get involved most effectively. Local level planning is bounded by broader terrestrial and lakewide objectives which should be taken into consideration. Planning on a watershed scale provides one way to link larger scale aquatic and terrestrial objectives. There is a need for greater interaction and communication between aquatic and terrestrial managers.

Mechanisms which are being used to address land/water linkages

A number of legislative and organizational mechanisms, are being used to make the link between aquatic and terrestrial habitats, although not all are currently applied for the three Upper Great Lakes. Forestry planning is required by law to take water quality into consideration. This is done using a

planning formula to set buffers and harvest allocations along waterways. In Ontario, specific rivers have task forces dealing with issues affecting the river and surrounding watershed. Similarly, in the States surrounding the Great Lakes, watershed councils composed of a variety of stakeholders have been formed for many of the larger rivers.

In Toronto, Ontario, making the link has been possible to some degree through the Metro Toronto Conservation Authority. There is a watershed management plan for each of the 5 watersheds in the city as well as a shoreline management plan. The Metro Toronto CA acts as a coordinating agency. There is still no link to open water planning for Lake Ontario. Watershed planning often needs a specific link to connect issues in the watershed to planning for a Great Lake. For example, trout in a watershed are the same trout which live at times in the lake.

The Lake Superior LaMP process seems to be the best example of how an umbrella group/program could be effective. There are ecosystem principles and objectives in place and a monitoring program is being developed which may be able to consider the links between land and water.

Barriers to developing linkages between aquatic and terrestrial ecosystems

The lack of direct communication and the absence of mechanisms for communication are important barriers to improving linkages between Great Lakes, aquatic and terrestrial managers. For example, in Michigan, watershed managers have little contact with fisheries managers or with researchers addressing issues in Lakes Superior, Huron, or Michigan. In Ontario, the land based component of municipal planning is separate from Great Lakes management. At the same time, Fish Community Objectives for the Great Lakes have not taken into account impacts from individual watersheds emptying into the lake. Although forestry planning does consider water quality, there is again very little direct communication with fish researchers or scientists studying aquatic ecosystems.

There is no hierarchy of importance between land and aquatic objectives. Should the links be investigated from the top down by looking at what is occurring on land and how that affects runoff areas, or from the bottom up, by deciding what is a desirable condition in the lake and looking at the changes which must be made upstream to attain that condition. Fish which live at times in a watershed (ie. tributary) and at other times in a Great Lake seem to be the only link between terrestrial management activities and aquatic impacts. There is a problem of finding a link for those watersheds for which no specific fish values exist. There may still be, for example, sediment loads which impact spawning grounds in the Great Lake. There also needs to be protection of other water quality, recreational and aesthetic values and objectives.

The approach so far seems to be to address management on a watershed by watershed basis. There are, however, over 685 tributaries in the Canadian part of the Great Lakes basin alone. Taking a piecemeal approach of looking at each watershed on an individual basis is a huge task.

What needs to happen to improve aquatic and terrestrial linkages?

We need a common, unifying goal which ties together a large area. For example, water pollution and health issues used to be a unifying factor. Objectives set with a large scale in mind need to be translated into objectives and targets which apply to the local level. Basically, management efforts for the whole of a Great Lake basin will be the sum of individual efforts considered within a larger context. There needs to be a consideration of values other than fisheries values. Water quality, recreational opportunities, aesthetic values and habitat objectives need to be included. We need to move from a "featured species" approach to an ecosystem based approach. Actively building links between land and water management requires compiling and sharing data on both aquatic and terrestrial features.

Ideally, there needs to be integration of efforts on a variety of organizational levels since there are stressors at a local level but also from outside the basin. A nested hierarchy of scales would include tributary watershed, Great Lake watershed, broad terrestrial classification (including part or all of a watershed), and continental scale. Multiple classification systems must be considered.

A number of factors will have to be considered in the management of a watershed ecosystem. There will be objectives for terrestrial ecosystems within which the watershed is located and other objectives for the aquatic ecosystem or lake into which the tributary/watershed empties. Management will be based on input from local communities and carried out within the context of the economic considerations for the region. One principle for action is to look at the interaction of different sets of objectives.

Above all, it is important to involve people. At the local level, interested stakeholders can be involved by setting up a management committee or watershed council following the approach of the Remedial Action Plan process.

Panel Two: "Moving from Ecosystem Objectives to Quantified Environmental Objectives and Indicators"

Comments from Panel Members:

Rob Steedman, Ontario Ministry of Natural Resources
Origins and Objectives of the Lake Superior Ecosystem Objectives and Monitoring Committee (organized under the Lake Superior Work Group of the Lake Superior Binational Program)

As one of its charges under the Lake Superior Binational Program, the Lake Superior Work Group is required to facilitate the development of ecosystem objectives and strategic ecosystem monitoring at the scale of the Lake Superior Basin. The Lake Superior Monitoring Committee (LSMC) and the Lake Superior Ecosystem Principles and Objectives Committee (LSEPOC) were established to lay the groundwork for this, and have delivered two key products. One product was the compilation of draft Ecosystem Principles and Objectives for Lake Superior, along with recommended indicators and targets to measure their implementation. Another product was the establishment of an integrative committee structure designed to foster communication and coordination among ecosystem monitoring professionals in the Lake Superior Basin.

Progress on two fronts is now possible and timely under a merged committee structure: 1) basin-wide integration of existing monitoring activities relevant to the Lake Superior Ecosystem Objectives (primarily chemical and biotic monitoring, at present); and 2) identification of some new approaches to monitor Ecosystem Objectives that are presently not addressed by existing monitoring programs (probably involving biotic, economic, political and cultural themes). The merged committee will be referred to as the Lake Superior Ecosystem Objectives and Monitoring Committee.

Development of Ecosystem Principles and Objectives, Indicators and Targets for Lake Superior was primarily a conceptual synthesis exercise, involving input from public advisory groups, agency experts, and the general public. These next steps are especially challenging and will require marketing the

Lake Superior Ecosystem Objective framework to the binational monitoring community - a diverse group whose membership ranges from agency technical experts to citizen volunteers.

The ability of the Lake Superior Binational Program to influence an ecosystem monitoring strategy in the Lake Superior basin will depend on our success as coordinators and facilitators. We can help integrate existing ecosystem monitoring activities by providing a basin-scale, binational context, while encouraging development of the innovative new approaches required for comprehensive, multi-sector ecosystem monitoring. It is particularly important that we re-examine the linkages of the Lake Superior chemical LaMP to strategic ecosystem monitoring, as this was not an explicit element of the Ecosystem Principles and Objectives, Indicators and Targets exercise.

Subtheme leaders will provide technical expertise and professional leadership in the binational aspects of each monitoring subtheme: "chemicals of concern", "terrestrial community health", "human health", "social and economic sustainability","aquatic habitat", and "aquatic community health". The subtheme leaders and their partners will be responsible for most of the progress that takes place regarding integration and development of binational ecosystem monitoring within each theme.

The role of the Superior Work Group and the Ecosystem Objectives and Monitoring Committee co-chairs will be to assist with strategic direction and integration of binational monitoring themes. This will be accomplished through break-out sessions with subtheme leaders at regular meetings of the Lake Superior Work Group.

The different monitoring subthemes will require different strategies for binational integration, and will have different criteria for progress. For example, monitoring programs for "chemicals of concern" are generally agency-based, highly technical, and already well-established in the context of federal, state or provincial regulations. A key objective will be the binational integration of analytical and interpretive approaches. Conversely, binational monitoring of "social and economic sustainability" has never been done in the Lake Superior basin and will require development and implementation of new quantitative methods and approaches. The Work Group, co-chairs and subtheme leaders will be required to recognize the complexity and diversity of the Ecosystem Objectives and Monitoring Committee's assignment, and seek solutions through innovative and adaptive collaboration with the Lake Superior monitoring community.

Paul Bertram, U.S. Environmental Protection Agency
Towards a Unified Set of Environmental Indicators for the Great Lakes

Many terms and definitions are related to the concepts of ecosystem objectives and indicators and considerable time and energy can be expended trying to apply definitions that are generally agreed upon. A number of organizing principles or frameworks are also currently in use. Each of the frameworks has its adherents, but in general, true environmental measures are desired to measure progress toward well-defined ecosystem objectives. The ecosystem objectives, therefore, are very important to the process of selecting indicators. Without an identification of a desired environmental state or condition, there will be no standard against which to evaluate the measured indicators.

To move beyond the setting of ecosystem objectives, which incorporate aspects of human society values and the environmental stresses being imposed on the ecosystem, consensus should be reached among the stakeholders on several issues:

- A set of commonly accepted definitions for "indicators" terms would facilitate discussion and minimize repeated misunderstandings based on differing definitions.
- The ecosystem goals and objectives for each Great Lake should be accepted by all the stakeholders. We should all be working toward the same end.
- The indicators of progress toward the ecosystem objectives must be quantitative. Some way must exist to measure the indicator.
- Each indicator should have a quantified desired end point, reference value, acceptable range, or other statement of the state of the environment we are trying to achieve.
- The interpretation of the indicator will be valid in the context of the desired end point. To measure progress toward an objective, we need to know both the standard and the current state of the environment.

The next State of the Lakes Ecosystem Conference (SOLEC), scheduled for October, 1998, will be organized around the theme of Great Lakes indicators. Therefore, an opportunity exists to use SOLEC '98 as a forcing function to reach consensus on a core set of indicators for the major components of the Great Lakes ecosystem.

SOLEC is a biennial conference for Canada and the U.S. to report and comment on environmental progress toward the goals of the Great Lakes Water Quality Agreement (GLWQA). SOLEC conferences in 1994 and 1996 examined the state of various components of the Great Lakes ecosystem through the use of indicators and provided subjective assessments of "good", "fair", "improving", etc.

To continue the SOLEC process in 1998 and beyond, Canada and the U.S. desire to identify a set of core indicators that will objectively represent the state of major ecosystem components for all Great Lakes basins. Future SOLEC conferences would include updates on the environmental status of these indicators and on progress toward ecosystem objectives. The SOLEC process is a rare opportunity to bring multiple agencies and organizations together to identify common objectives and data needs, and to encourage cooperative data collection, evaluation and reporting.

In preparation for SOLEC'98 and beyond, a "SOLEC Indicators List" is being compiled that will include measures for major ecosystem components, including human health and socio-economic issues. The SOLEC Indicators List is envisioned to define the core set of measurements for the Great Lakes which will be used by SOLEC and other stakeholders to track progress toward environmental objectives.

Several attempts have been made to identify goals, objectives and indicators for parts of the Great Lakes ecosystem. Some of the major activities include:

Lakewide Management Plans (LaMPs). For each Lake, the LaMP will identify ecosystem objectives and a comprehensive set of indicators. Progress toward indicators was achieved for the LaMP for Lake Superior and for the Toxics Management Plan for Lake Ontario.

International Joint Commission. The IJC has identified nine "Desired Outcomes" for the Great Lakes (roughly equivalent to ecosystem objectives), five of which are related to human health. Several categories of indicators were recommended to be measured and reported for each outcome.

Great Lakes Fishery Commission. The GLFC has released or is working on lake-by-lake fish community objectives which imply a need for measuring and reporting on the status of various fish populations and habitat conditions.

SOLEC '94 and SOLEC '96. For the SOLEC Conferences, the background papers and the Integration Paper identified numerous indicators related to the health of various components of the Great Lakes ecosystem.

These activities have considered the Great Lakes ecosystem from different perspectives. Determining which perspective is best is like determining whether a pizza should be sliced in pie-shaped pieces or in squares. The preferred approach depends on the expectations of the user. In Table 1, below, the major ecosystem categories considered by the IJC Indicators of Progress, SOLEC '94 and SOLEC '96 are presented in relation to the LaMP categories. The resultant patchwork demonstrates the differing perspectives that each activity has used to approach Great Lakes problems. Similarly, Table 2 presents a similar analysis based on the LaMPs and the Fish Community Objectives that have been developed in cooperation with the Great Lakes Fishery Commission.

The SOLEC process will not attempt to impose a uniform set of indicators onto these and other user groups, nor will it discourage new indicator development work. However, the SOLEC Indicators List is expected to provide the basis for future monitoring and data gathering efforts.

The SOLEC Indicators List will be a distillation of indicators proposed by Great Lakes stakeholders. Based on an electronic, searchable database, each indicator will be associated with a number of attributes, such as user group, geographic component (i.e., open water, nearshore, terrestrial, coastal wetlands, etc.), human health, lake basin, ecosystem objective being supported, quantified end point or desired state, data availability, implications for environmental management, etc. A retrieval of indicators associated with, say, "Lake Erie Coastal Nearshore" will provide a list of indicators relevant to this area for SOLEC reporting.

A series of workshops will be conducted for stakeholders, technical experts and environmental managers to assess the set of indicators associated with key attributes (eg. lake basin, geographic component, ecosystem objective, etc.) for the criteria of "necessary and sufficient" for the reporting under the SOLEC process. The resultant subset of indicators identified through this process will be proposed as the SOLEC List, and it will be further reviewed at SOLEC'98 and revised as needed.

We seek your help and suggestions!

For further information about SOLEC and Great Lakes indicators, visit: www. epa.gov/glindicators

To become involved in the indicator selection process, contact:
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Table 1. Requirements for Environmental Indicators; Comparison of Ecosystem Objectives, Desired Outcomes, Focus Geographic Areas, etc.

Lake Ontario LaMP	**Lake Superior LaMP**	**Lake Michigan LaMP**	**IJC Indicators of Progress**			**SOLEC 94**		**SOLEC 96**		
Ecosystem Objective	Ecosystem Objective	Ecosystem Objective	Desired Outcomes			Cluster Papers		Areas of Focus		
Aquatic Communities	Aquatic Communities	Aquatic Communities		Biological Community Integrity and Diversity	Virtual Elimination of Inputs of Persistent Toxic Substances	Aquatic Communities	Contaminant Stresses			Near shore Waters
Wildlife	Terrestrial Wildlife	Wildlife							Coastal Wetlands	
Habitat	Habitat	Habitat	Absence of Excess Phosphorus			Aquatic Habitat and Wetlands	Nutrient Stresses	Near shore Terrestrial Ecosystems		
			Physical Environment Integrity							
Human Health	Human Health	Human Health	Fishability			Human Health				
			Swimmability							
			Drinkability							
			Healthy Human Populations							
Stewardship	Developing Sustainability	Stewardship	Economic Viability			Economic Stresses and Mitigating Activity		Land Use		
	General Objective for GLWQA									
								Information and Information Management		

Table 2. Requirements for Environmental Indicators: GLFC Fish Community Objectives

Lake Ontario LaMP Lake Michigan LaMP	Strategic Great Lakes Fisheries Management Plan	Fish Community Objectives for the Great Lakes									
		Superior	Erie		Michigan		Huron		Ontario		
Lake Superior LaMP	Goal Statement	Fisheries Objectives	Fish Community Objectives		Fish Community Objectives		Fish Community Objectives		Fish Community Objectives		
Aquatic Communities	Fish Communities	Forage	Forage	Contaminants	Planktivore	Toxic Chemicals	Prey	Genetic Diversity	Under Revision		
		Predators	Western Basin		Salmonine (Salmon and Trout)		Salmonine (Salmon and Trout)				
			Central Basin		Inshore Fish		Percid, Esocid, Catfish, Coregonine, Centrarchid, Sturgeon				
			Eastern Basin		Benthivore						
		Other Species	Endangered Species		Other Species		Species Diversity				
		Sea Lamprey			Sea Lamprey		Sea Lamprey				
			Food Web								
Wildlife											
Habitat		Habitat	Trophic Conditions				Habitat				
			Near shore Habitat								
			Riverine/ Estuarine Habitat		Riverine/ Anadromous Species						
			Fish Habitat		Fish Habitat						
Human Health		Consumption Advisories	Consumption Advisories		Human Consumption of Safe Fish						
Stewardship/ Sustainability											

<u>Mark Ebener, Chippewa/Ottawa Treaty Fishery Management Authority COTFMA</u>
Development of Quantifiable Habitat Objectives for Lake Superior

The Lake Superior Committee (LSC) of the Great Lakes Fishery Commission assigned the Lake Superior Technical Committee (LSTC) to discuss the problems of linking quantified environmental objectives to stated fish community goals (FCO's). The LSTC has discussed the technical problems associated with quantitative analysis of habitat, and assessed if quantitative habitat goals can be developed that allow achievement of FCO's. For example, how much spawning habitat will be necessary to achieve the lake trout rehabilitation goal, or how much food is necessary to produce a sustainable four million pound harvest of lean lake trout?

The Habitat Advisory Board (HAB) has made a list of the necessary components of FCO's that can be used to develop quantitative habitat objectives for each Great Lake. The components were taken from a HAB workshop on environmental objectives that took place in November 1993. Basically, FCO's should specify:

1. **Long-term relative abundance of all species. The LSTC feels we can currently do this for the primary species like lake trout, herring, and whitefish.**
2. **Seasonal distribution.**
3. **Biomass.**
4. **Productivity. The LSTC questions whether productivity means the elaboration of fish flesh, or just simply harvest? Currently, the LSTC can estimate production in terms of historic yields.**
5. **Harvest strategies. Is it possible to use the current approaches being taken by the agencies in setting fish consumption advisories?**
6. **Desired genetic diversity. The LSTC can identify some of the historic stocks of lake trout (leans, humpers, siscowets, half-breeds).**

Other needs which must be identified in order to achieve quantitative habitat goals include:

1. **Habitat definition and quantification. There is a need to determine the scale of resolution and outline the reasons for the scale chosen. As well, we need to identify what is critical habitat for each species of concern.**
2. **Definition of sensitive species (sturgeon, brook trout, walleye).**
3. **Key stressors on the aquatic environment, such as toxins, water quality, exotics, physical habitat.**
4. **Determination of which encroachments are critical to habitat.**

Generally, the LSTC feels that habitat is an issue only in the tributaries, harbours, and embayments, not the open and near shore waters of Lake Superior. Most of the near shore and open water habitat is generally unchanged from historic times, whereas the vast majority of the tributaries, harbours, and embayments have born the brunt of habitat destruction around Lake Superior. Species like lake trout, herring, and whitefish probably have sufficient amounts of habitat to sustain themselves and achieve our present FCO's. Rehabilitation of tributary and embayment habitat is essential to indigenous species like lake sturgeon, coaster brook trout, and walleye. The LSTC recognizes the need to identify the specific habitats important to these three species. The subcommittee status reports and rehabilitation plans should assist in identifying these critical habitats within the Lake Superior basin.

The LSTC generally reached consensus on the following points necessary to reach quantitative fishery habitat objectives:

1. **While it appears that toxic contaminants are not limiting reproduction of Lake Superior fishes such as lake trout, whitefish, and lake herring, the LSTC does not know if reproduction could be better if toxic contaminants were at lower levels, or eliminated completely.**
2. **The LSTC cannot, at this time, describe the amount of square meters of habitat necessary to sustain the important fishes (lake trout, whitefish, walleye, herring, sturgeon, brook trout) and reach FCO's. What may be possible is to name the streams that historically contained lake sturgeon and may be important for rehabilitation of this species.**
3. **The open water and near shore habitat of Lake Superior is probably in sufficient quality to reach any specific FCO which depend primarily on that type of habitat, whereas the tributaries, harbours, and embayments do not have the amount of habitat necessary to achieve FCO's for species which depend heavily on those areas like sturgeon, coaster brook trout, and walleye.**

To further assist with development of new FCO's, the LSC asked the LSTC to consider for each species listed in FCO's the existing knowledge about habitat requirements and environmental stresses to each species. The LSTC reached some consensus on the charge from the LSC and outlined the following strategies for addressing the charge:

- **The sea lamprey control program has done extensive work at quantifying habitat and distribution of each habitat type in many sea lamprey producing streams around Lake Superior. The sea lamprey control agents will provide the LSTC with a list of streams where they have conducted habitat work, and they will describe the amount and distribution of each habitat type in the streams. The Sea Lamprey Barrier Task Group will also be able to identify spawning habitat for various fishes that exists below the current barriers.**
- **The variability of stream flow may be a good indicator of ecosystem health in tributaries.**
- **For lake trout, we will use the current management areas as the spatial scale for important habitats within Lake Superior. Spatial resolution for other species will be different. The LSTC subcommittees will do their own evaluations of spatial resolution and critical habitat.**
- **Individuals from the LSTC will describe quantifiable habitat within each jurisdiction for species listed in the FCO's other than walleye, lake sturgeon, and brook trout. Individuals need to define what is critical habitat for each fish species and identify that habitat for protection as illustrated on the map of important habitat in Lake Superior.**

The LSC also asked the LSTC to develop a matrix that illustrates research and assessment activities of each agency as they relate to aquatic community indicators for Lake Superior. The matrix should show within the offshore, near shore, harbour and embayments, and tributary habitats of Lake Superior the indicator(s) each agency is measuring. The basic indicators developed by the LSTC are trends in abundance of indigenous and non-indigenous species, the amount of natural reproduction, and trends in contaminants. The assessments listed in the matrices do not always occur every year. The matrices were completed by the LSTC and forwarded to the LSC.

Discussion

- **For the sake of simplicity, there should be a common set of objectives and indicators. Problems arise with interpretation of data if the data is not collected in a similar (ie. standardized) way. For example, whitefish has been suggested as an indicator across the Great Lakes basin. It is apparent that something is going right for this indigenous species in many areas of the Great Lakes. Perhaps there would be 5 or 6 common indicators for the Great Lakes to provide standardization of methodology.**
- **We can work toward a common set of indicators but must realize that they will probably not be suitable for all users on all lakes. The level of detail which FCO (Fish Community Objectives) requires is greater than that required by the Ecosystem Objectives. A common set may exist, but there are user group and agency differences.**
- **It is desirable to have a unified set at some level. The common indicators should arise from ongoing processes in the basin which may be examined to determine areas of commonality. The process is driven at a regional or lakewide scale.**
- **We want just a few common indicators which are based on a trophic scale (benthic, *Diporea*, water quality, lake trout, emerald shiner (coastal indicator)).**
- **I accept the philosophy that a common set is useful, as long as none are mutually exclusive. For example, one water quality parameter at a certain measurement may not apply to all lakes.**
- **If we found one thing affecting lake trout in only L. Ontario, then we would measure only that one measurement and not in other lakes. Stressors are different for different species in different ecosystems.**
- **We may have an indicator which is a "top predator", and this may be a different species in each lake. However, the status of this species says nothing about what is causing the impairment. The causes may be another whole set of indicators.**
- **Stream flow has been identified as a good indicator linking land use with water quality. Sea Lamprey Control has lots of data on stream flow.**

III. Moving Forward: Considerations and Next Steps (Breakout Sessions)

Objective: To identify key ideas and practical considerations for the development and implementation of habitat objectives and quantifiable targets.

Background Information

Status of Lakewide Management Plans (Feb. 1997)

Summary

1. **Under the terms of the Great Lakes Water Quality Agreement, Canada and the U.S. are obligated to produce a Lakewide Management Plan (LaMP) for each of the Great Lakes.**
2. **LaMPs will provide the framework for coordination and cooperation between the various agencies and jurisdictions, integrating existing land and water-based planning and activities. This includes development of a set of ecosystem-based principles, objectives and indicators, endorsed by agencies and the public on both sides of each lake, to provide direction for management plans.**
3. **LaMPs have evolved from dealing solely with critical pollutants. Their goal is to restore and protect beneficial uses in each lake basin through an ecosystem approach, improve agency efficiency in program delivery and promote consensus solutions for contentious issues to reduce user conflicts. As such they must be compatible and fully integrated with other initiatives such as RAPs and Fish Community Objectives.**

Lake Superior

The Binational Program to Restore and Protect the Lake Superior Basin begun in 1991 states that United States and Canadian environmental protection programs will be expanded, coordinated and accelerated in two major areas:

A. **a zero discharge demonstration program devoted to the goal of achieving zero discharge or emission of certain designated persistent bioaccumulative toxic substances, which may degrade the ecosystem of the Lake Superior basin, and,**
B. **a broader program of identifying impairments and restoring and protecting the Lake Superior basin ecosystem. This broader program will incorporate the LaMP process and will also deal with non-chemical issues such as habitat restoration and protection, special designations and sustainable development in the basin.**

The Binational Program is directed by a multi-agency Task Force of senior managers that oversees the two groups responsible for program delivery; the Lake Superior Work Group (the agency working committee, including three representatives from OMNR) and the Lake Superior Forum (the public advisory committee). Each group has a number of subcommittees assigned specific tasks or program areas (e.g. habitat, communications, zero-discharge).

The Stage 1 Lakewide Management Plan - Current Status of Critical Pollutants for Lake Superior was completed in September, 1995, after extensive public review, and presented to the IJC. Stage 1 involved problem identification and focused on chemical stressors. The Draft Stage 2 LaMP - Load Reduction Targets for Critical Pollutants, is open for public and agency review until the end of February, 1997. The Work Group and Forum also released the discussion paper Ecosystem Principles and Objectives, Indicators and Targets for Lake Superior, greatly expanding upon the one objective for the lake outlined in the GLWQA, and providing a vision for the future of the basin. The LaMP and ecosystem objectives documents are Volume II and Volume IV respectively of five proposed reports under development through the Binational Program that will be integrated with, and build upon other initiatives such as RAP's and Fish Community Objectives. Other volumes in preparation include an introduction to the basin, its economy and inhabitants (Volume I) and Volume III, a Lakewide Management Plan for Non-Chemical Stressors which will incorporate many of the aspects of the broader ecosystem program beyond critical pollutants. Volume V will present a comprehensive management plan for the Lake Superior basin ecosystem and will amalgamate the first four volumes.

Lake Michigan

Unlike the four Great Lakes which have Canada-U.S. boundary waters, the United States has the sole responsibility for delivering the Lake Michigan LaMP. The USEPA is the lead agency for this LaMP, working in cooperation with other U.S. federal agencies, the states of Michigan, Wisconsin, Illinois and Indiana, and local authorities. The Revised Draft Lake Michigan LaMP for Toxic Pollutants (Stage 1), was released for public review in September, 1993. The document states that its focus will be on the reduction of loadings of critical pollutants to Lake Michigan and that it is not intended to address all of the issues in the lake such as habitat loss and overfishing. The draft does propose ecosystem objectives for aquatic communities, wildlife, human health, habitat and stewardship, but notes that the USEPA views the LaMP as one component of a larger Great Lakes 5-Year Strategy being developed to achieve these objectives. In addition, a major effort is underway to develop a mass-balance model for the lake which will help in the development of the future stages of the LaMP.

Lake Huron

There is little movement on a Lake Huron LaMP at this time as a result of higher agency priorities elsewhere. The information that is generated and the experience gained on the other Great Lakes should hopefully allow for smoother progression on an eventual Lake Huron LaMP. At present, there is an opportunity to begin developing ecosystem objectives for Lake Huron, which would provide a significant head start in the LaMP process.

Lake Erie

The Lake Erie LaMP process has a structure very similar to that of Lake Superior, with a management committee, a Work Group and a binational Public Forum, and associated subcommittees. A Draft Stage 1 LaMP is under development with a projected completion date of fall 1997. The Lake Erie LaMP is attempting to use the ecosystem approach with full consideration for impairments in all aspects of the ecosystem. Ecosystem objectives are also under development.

Lake Ontario

The Lake Ontario Secretariat is a four-party (DOE, MOEE, USEPA, New York Department of Environmental Conservation - NYDEC) committee that produced the Lake Ontario Toxics Management Plan (LOTMP) in 1989. The Secretariat has just released a draft Stage 1 LaMP, also with a focus on critical pollutants. In a separate but related initiative that has been going on for several years, biological indicators to measure progress towards ecosystem objectives (required under the GLWQA) are being selected by an Ecosystem Objectives Work Group.

Lake Superior

Summary and Recommendations

The Lake Superior discussion formulated the next steps of how to move from the existing "Ecosystem Principles and Objectives" document, which contains draft indicators and targets, to develop an on-the-ground monitoring effort. The people who should ideally be involved in this process were listed and possible roles were suggested for academia, volunteers, protected area managers, the Lake Superior Ecosystem Cooperative, First Nations, water quality and natural resource agencies and resource-based industries. Some discussion followed about ways to involve these sectors including a sign-on process similar to the "Great Lakes Ecosystem Charter" , voluntary "best business practices", and an official plan for each community which would incorporate Lake Superior objectives and integrate with ongoing forestry initiatives, such as the development of Forest Products Standards.

Recommendations

- **The Fish Community Objectives and the Aquatic Community Objectives from the Ecosystem Principles and Objectives should be unified.**
- **Revisions to the Ecosystem Principles and Objectives should consider both existing and potential monitoring initiatives.**
- **There is a need for upper management in agencies to provide an equal level of support for the Lakewide Management Planning process as for the Sustainable Forestry initiatives if there is to be effective integration of the two.**
- **Involvement in a basin-wide monitoring program must be developed on an on-going basis. There are a wide variety of groups which could potentially be involved to some degree in carrying out a portion of a monitoring program.**
- **A group like the Lake Superior Binational Forum should be approached to coordinate monitoring efforts by volunteers around the basin.**

Current Guidance for Objectives and Targets

Several organizations have developed processes in the Lake Superior Basin to identify indicators and specific targets by which to measure ecosystem status. The Lake Superior Binational Program has developed ecosystem objectives and targets for the Lake Superior Basin and the Great Lakes Fisheries Commission has a technical committee for Lake Superior which has set Fish Community Objectives. It is important that the objectives and targets of different resource management organizations or agencies in the basin be compatible.

There are other large-scale initiatives which would include the Lake Superior Basin. One of these is a new planning regime in Ontario, "Ecoregion Plans for Ecosystem Management" which considers primarily land-based processes on an ecosystem level. It is not certain how these plans may be integrated with the Lakewide Management Plan.

Who is involved and who needs to be

Many agencies involved with resource management around the basin are not part of the Lakewide Management Planning (LaMP) process but should be to some extent.

Academia

Funding and direction could be provided to encourage research into development of objectives and targets and a monitoring strategy. This could be tied in, at least for biological objectives, with the Lake Superior Biological Conference, an annual meeting of the academic community. It is important that objectives are prioritized before a monitoring program is established. Funding may be possible through such programs as Great Lakes Sea Grant or Great Lakes Protection Fund. The Lake Superior Binational Program could be the lead in bringing people together to put together some funding proposals. One proposal is to gather capital for a Lake Superior fund from which to draw for monitoring activities.

Volunteers

There are already a number of volunteer monitoring activities which could support monitoring of ecosystem objectives and targets in the Lake Superior Basin. Some programs currently in place include the Lake Watch program, Forest Bird monitoring program, Marsh Monitoring program and surveys for herons. Groups such as angler and hunter organizations are established and may have an interest in participating in monitoring activities. A Community Wildlife Involvement Program (CWIP) exists in Ontario which provides funding for some management activities organized by community volunteers.

Involving volunteers requires an organizational structure and agency support. Some level of staff input may be needed to ensure that the data is of sufficient quality that it may be used for management purposes. Some funding may be needed for training of volunteers. In addition, one must be careful not to overwhelm volunteers by expecting too much from them such as participation in more than one monitoring activity. The group suggested that a challenge be presented to the Lake Superior Binational Forum to co-ordinate a monitoring effort involving volunteer groups.

Protected Areas staff

Many parks are involved in some kind of monitoring activity. (Protected areas managers are developing a listing of monitoring activities ongoing in protected areas - Editor). There may be a way to expand on efforts which have been initiated in parks to areas outside the park boundaries.

Lake Superior Ecosystem Cooperative

A liaison needs to be developed between the Lake Superior Ecosystem Cooperative and other ecosystem initiatives such as the Lake Superior Binational Program and the Great Lakes Fisheries Commission.

First Nations

Canadian First Nation involvement should be considered either on a voluntary basis or with some funding to support monitoring programs.

Tribal Natural Resources and Environmental Management Programs

In order to integrate monitoring activities with tribal organizations, we need to first have a good understanding of how they operate and what type of barriers may impede their participation. Individual groups must be offered the opportunity to decide if and how they want to participate since not all tribes are represented by the bigger organizations. Many bands are in the process of developing their own programs, so the timing is appropriate to try and involve them in developing and incorporating objectives. One opportunity to approach these groups is at the yearly meeting of the tribes and Native American Fish and Wildlife Service each September.

Water quality agencies

There must be communication between water quality agencies and those agencies and groups dealing with habitat issues in order to understand the implication of water quality decisions on fish and wildlife issues.

Resource industries

Companies such as Ontario Hydro and various timber companies should also be involved in water quality issues and resource planning. It may be possible for companies to alter or adjust their present monitoring programs to include monitoring for other objectives as well. The question was raised as to whether it was appropriate to ask companies to change their own program since they already have legal commitments to specific regulatory programs.

State of Information

Participants felt that in many cases there is not enough known about the effects of some objectives in order to set hard targets. Some indicators have recommended targets but many do not. It was suggested that a "weight of evidence" approach be used to setting targets.

Possible Approaches and Next Steps

One of the impediments to fully integrating the resource management planning process for Lake Superior and surrounding terrestrial ecosystems is the discrepancy in the level of support from upper management within resource agencies. Presently, development of sustainable forest management practices and indicators of terrestrial and forest health have greater legislative and political support.

It is also important that there is cooperation between the various agencies and organizations directly involved with aquatic ecosystems who have been part of the LaMP process to date. The Lake Superior Technical Committee of the Great Lakes Fisheries Commission is planning to revise the Fish Community Objectives with input from representatives of the Lake Superior Binational Program. The Fisheries Commission will be developing quantified environmental objectives, to support the Fish Community Objectives, and these should be integrated with the Binational Program's Ecosystem Principles and Objectives. The Lake Committee is holding a meeting in March 1997 to begin this process of integration.

The next step is to revise the draft objectives and targets developed by the Lake Superior Binational Program to develop a number of specific targets which would be possible to monitor. To accomplish this within the Binational Program, the Ecosystem Principles and Objectives committee has now been merged with the Monitoring Committee. In the process, the Lake Superior Technical Committee will work closely with the Aquatic Communities subgroup of the Monitoring Committee. Agencies which actually monitor aquatic communities need to be involved.

Suggestions to get a meaningful commitment from groups not currently involved with the Binational Program

A process similar to that of the Great Lakes Ecosystem Charter could be used to get support for the "Lake Superior Vision" , developed by the Lake Superior Binational Forum, and for the Lake Superior Principles & Objectives. The objectives and targets could be modified depending on feedback from this exercise. The goal would be to include such organizations as municipalities, townships and watershed councils and use support by key groups to encourage buy-in from other sectors.

The idea of a voluntary "best business practice" may be used to increase participation. A Best Management Practices Manual was developed in 1994 in Michigan by fisheries, water quality and forestry agencies for use by forest management companies. Fisheries or water quality agencies could assess progress through a system of audits or some other means of recognition.

Ideally, the official plan for each community would support and even incorporate Lake Superior objectives since official plans and master plans largely determine community planning. It may be appropriate to recognize communities, industries and other groups which incorporate the objectives by establishing a Lake Superior Binational Program "Honour Roll". At the same time, a "Dishonour Roll" could be established for those who do not comply with the objectives.

Lake Superior environmental and ecosystem objectives could be incorporated into the development of Indicators of Sustainability for Forest Ecosystems used to certify products promoted by the International Standards Organization. This approach may also be appropriate for the Forest Products Standards Organization and the Corporate Ecosystem Management Program.

Environmental and ecosystem objectives could be treated as an accepted part of planning for the Environmental Review process. For example, established objectives may be considered in the relicensing of particular activities, such as dams.

Lake Michigan

Summary and Recommendations

The group raised a number of key management issues which have implications for development of lakewide objectives and for the process of involving basin residents in the development of those objectives. Issues of concern included the acceptability of stocked species within the lake fish community, tribal fisheries, sand management along shorelines, fish consumption advisories, information dissemination and north-south discrepancy on environmental issues across the lake.

Much of the discussion about the next steps for developing ecosystem and environmental objectives for Lake Michigan focused on the redevelopment of a Stage One Lakewide Management Plan (LaMP) document for the lake. One of the most important aspects of

developing a lakewide plan is the involvement of stakeholders in the process, among them the Fisheries Commission Technical Committee for Lake Michigan, agencies from states surrounding the lake and the interstate chiefs. Other potential interest groups are sportsman's clubs, watershed councils, the boards of land trusts, riparian owners, timber companies and railroads.

Recommendations

- **There must be cooperation between the LaMP Technical Committee (TCC) and the Fisheries Commission Technical Committee (FCTC) and an active involvement of the FCTC in the LaMP process.**
- **Building relationships around the Lake Michigan basin is more important to the success of lake management planning than the actual LaMP document which will be produced in the next year. Development of a workable Lakewide Management Plan is an iterative process. The LaMP document to be produced this year (1997) must be considered as just the first step in a process which will make many changes to this draft document.**
- **It is essential to bring in an aspect of land use and land stewardship into the LaMP. In areas with a large population base, these links may best be developed on a watershed by watershed basis using watershed management councils to involve the appropriate people. In areas of less population, riparian owners, including timber companies and railroads, should be involved.**

Some Key Issues for Lake Michigan

- **Should we be attempting to return the composition of fish species to "presettlement" conditions, or should we accept that stocked species, such as salmon, are now reproducing naturally and are an established species in the fish community.**
- **Tribal fisheries will have an increasing impact on fisheries management for the lake. A new consent agreement will be needed in the year 2000. Reaching agreement and working cooperatively will be increasingly difficult since new bands are forming and the courts have begun to be involved in making changes to the Tribal Fisheries Agreement (amended in 1996).**
- **A sand management plan is needed for the whole lake which looks at the causes of habitat alteration beginning at the land/water interface in the tributaries.**
- **There is a north-south discrepancy on Lake Michigan in terms of aerial deposition of toxics and pollutants into Lake Michigan, population levels and related impacts from development and recreation, and dependency on resource-based industry. The more highly populated southern metropolitan areas are contributing more to airborne deposition that the northern part of the lake. The north is more sparsely populated and would require a different approach to involving residents in lake management than for southern residents.**
- **There is a problem with coordinating the collection and distribution of information among different groups and agencies. Different states collect information in different ways, and information on one topic, for example, spawning habitat, is distributed across many different agencies.**

Current guidance for targets and objectives

Fish Community Objectives have already been developed for Lake Michigan by the Lake Michigan Technical Committee of the Great Lakes Fisheries Association. It was suggested that a broader discussion about targets is needed which expands on lake community objectives.

A stage one LaMP was produced for Lake Michigan in 1993 which focused on toxics and was based largely on objectives developed for Lake Ontario. In 1991, there was a mailing to 500 people in the Great Lakes basin to assess if the objectives developed for Lake Ontario were applicable to Lake Michigan. Following the mail-out, approximately 50 people were invited to a workshop to discuss in greater detail which objectives were appropriate. There were few changes made to the objectives developed for Lake Ontario, and the LaMP document was produced based on the results from that workshop. The relevant information from the 1993 document needs to be included in the revised LaMP to be published in 1997.

No further initiatives were mentioned which have lake-oriented objectives and which could provide additional guidance.

Who is involved, who needs to be involved

The discussion on who should be involved centred around the process which has been proposed and which will be implemented by the USEPA to put together a revised LaMP, Stage One document.

The Fisheries Commission Technical Committee (FCTC) for Lake Michigan has been asked to provide indicators for the aquatic community objectives for the LaMP. Up to now, meetings of the Michigan LaMP Technical Coordinating Committee (TCC) were attended infrequently by the FCTC. There is a need for greater integration of the LaMP TCC and the FCTC and involvement of the FCTC in the LaMP process.

The state agencies from states surrounding Lake Michigan need to work more closely together and should be involved in development of the LaMP.

The interstate chiefs are already starting to work together on fisheries issues. It is critical to involve the four chiefs in the FCTC.

The TCC is planning to have a information gathering road trip to reach state and federal agency representatives as well as appropriate local groups which already exist, such as sportsman's clubs, watershed councils, and boards of land trusts or conservancies which acquire and hold land to meet a variety of different missions.

The group recommended that the LaMP incorporate the idea of land stewardship and address land issues. Riparian owners may be an important group to get involved, as well as watershed groups, timber companies and railroads. The LaMP should identify areas where there are no watershed councils, and rivers where there is no population centre. Other groups to contact are those involved with protected areas, such as state parks, and recreation groups.

State of information

For some important issues, such as the status of lake trout in Lake Michigan, there have been 20 years of research and still no definite answers about what is driving population levels. Scientists cannot say whether it is genetics or habitat which is the critical factor controlling the lake trout population. Managers assume that spawning habitat in northern Lake Michigan is pristine and that the spawning shoals in southern Lake Michigan are overrun with predators. The issue becomes how to manage without definite answers about the factors behind population fluctuations and without spending another 20 years researching this topic. Managers feel that there is still an information void at present about spawning habitat.

Possible approaches and next steps

Since Lake Michigan is at the beginning of a process to restart development of a Lakewide Management Plan, much of the discussion in the breakout group about the future direction of management on Lake Michigan focused on the direction to be taken in development of a LaMP. The result was a number of suggestions about what the updated LaMP should look like and what is important to consider when developing it.

The most important aspect of the process to develop a Lakewide Management Plan is getting people involved. There will really only be cooperation with and participation in the LaMP process when on-the-ground changes start occurring. The LaMP document itself will have no real meaning until buy-in from different agencies and groups is achieved. Team building should be included in the objectives section of the LaMP. As well, the LaMP document should not be too long, so that there is a reasonable chance that people will read and review it. One way to stimulate public involvement is to promote the development of watershed management councils on every river, following a RAP-type of process.

The Lake Michigan LaMP should be a pointing device which gets people working on issues and establishes a means of bringing together sources of information. The district managers present at the discussion reiterated the importance of establishing a way to coordinate information gathering and distribution. It may be appropriate to have a section in the LaMP listing sources of information relevant to management issues in the lake. Providing a means of exchanging information would encourage involvement and further the process of developing relationships within the Lake Michigan basin. One option to be considered during the USEPA road trip is to provide some information, for example, a broad rating of streams in terms of habitat potential, in order to stimulate discussion about concrete management issues to which most resource managers around the lake can relate.

There were some comments about the approach to be taken by the USEPA which is considering tributaries as sources for pollutants into the lake, but is not intending to address the full length of the tributaries and the entire watershed in the LaMP. The group felt that there needs to be a section on the land and water linkages and the implications that terrestrial management practices have for streams and ultimately the lake environment.

Lake Huron

Summary and Recommendations

Lake Huron has not yet begun the process of developing a Lakewide Management Plan. The discussions at this breakout session were a first step in that development process. The present situation for Lake Huron was summarized particularly with respect to existing policies, programs and undertakings which have lakewide objectives. Among these are the development of Fish Community Objectives by the Great Lakes Fishery Commission, specific water quality and watershed objectives associated with the Remedial Action Plan process and with watershed councils in the U.S., and various management initiatives such as designation of provincial, state or federal parks, the North American Waterfowl Management Plan, and the Sea Lamprey Control program. Looking to Lake Superior as a model, some of the same agencies and groups who are involved in the Lake Superior Binational Program should be involved in the Lake Huron LaMP process.

Recommendations

- **The next step in development of a LaMP could involve a workshop to define the status of habitat in the lake and develop habitat objectives and targets.**
- **A scoping meeting is needed to address ecosystem objectives for the lake.**

Some Key Issues for Lake Huron

- **A LaMP has not been developed to date for Lake Huron due to the direction of available funding to other Great Lakes LaMPs.**
- **Fisheries managers are concerned that lakewide targets may not be applicable because of the variation in interests between different groups involved in the fishery. They acknowledge that it may be possible to accept the same main goals.**

Initiatives with objectives affecting all or part of Lake Huron

Fish Community Objectives

To date, there have been fish community objectives approved for Lake Huron which set out a vision and implied standards for at least the fish community.

Water quality issues

There are specific objectives for each of the Remedial Action Plans (RAP's) on Lake Huron which include St. Mary's River, Severn Sound, Collingwood Harbour, Spanish Harbour, St. Clair River and Saginaw Bay. Outside of the RAP process, there are specific water quality objectives developed in the U.S. by some watershed councils as part of watershed management plans. Legislation establishes minimum water quality standards for industrial and sewage waste, as outlined in Annex II of the Great Lakes Water Quality Agreement (IJC 1987) and in provincial or state legislation, such as MISA regulations in Ontario.

Habitat issues

Federal, state and provincial agencies have designated special management areas which include designations such as parks or national forests. Parks Canada wants to identify marine parks in each of the Great Lakes and they have targets for aquatic and terrestrial representation in all ecoregions of the country. Michigan DNR has plans for Saginaw Bay which address some habitat issues. The North American Waterfowl Management Plan has broad objectives which include areas on Lake Huron. For example, a plan for Hullett Marsh, developed by Ducks Unlimited, has a number of requirements for waterfowl which overlap with beneficial fish habitat. Sea Lamprey Control programs target all the Great Lakes. Barrier dams have been constructed on many rivers around the Great Lakes, including Lake Huron, to decrease available spawning habitat and distribution potential for sea lamprey. Dredging is carried out in many harbours and has major impacts on aquatic habitat. There is a Contained Disposal Facility (CDF) in Saginaw Bay and potential for a CDF in St. Mary's River.

Several government planning mechanisms have implications for lake planning and objectives. Plans may be protective, such as a designation for 'Wild and Scenic River', they may attempt broad shoreline management through processes such as Coastal Zone Management (CZM) or they may address a resource in the lake, for example, the Joint Great Lakes Fisheries Management Plan (SGLFMP). A number of planning processes for land use, among them municipal and county official plans, crown land and national/state forests management plans, all have implications for the quality of waterways and water bodies contained in or downstream from those areas. Many tribes in the U.S. have their own land use plans and their treaties often include resource and land use rights along shorelines.

<u>Who should be involved in the LaMP development?</u>

A number of the agencies which have been key participants in the Lake Superior Binational Program would likely be part of the LaMP development on Lake Huron. These agencies include: Ontario Ministry of Natural Resources (OMNR), Michigan Department of Natural Resources (DNR), Michigan DEQ (Department of Environmental Quality), the Chippewa-Ottawa Treaty Fishery Management Agreement (COTFMA) and the US Fish and Wildlife Service. The Canadian Department of Fisheries, the U.S. Fish and Wildlife Service, Parks Canada, U.S. Forestry Service and the Great Lakes Fisheries Commission also provide input to the LaMP program. Other key groups include the Lake Huron Fish Advisory Committee, tribal conservation committees and some environmental managers, for example, from the Michigan United Conservation Clubs.

Participants suggested that several additional groups and agencies could be involved with the LaMP process. It would be desirable for the Canadian First Nations to be involved in the same way that many tribal organizations in the U.S. are represented. A number of other government agencies including the Ontario Ministry of Agriculture, Food and Rural Affairs; U.S. Army Corps of Engineers and Conservation Authorities. Tourism, recreation and industry organizations could be involved such as the North Ontario Tourism Outfitters, the Georgian Bay Association, the Ontario Federation of Anglers and Hunters, the Ontario Commercial Fisheries Association and the Lake Carriers Association. Some environmental groups may have valuable input, among them Great Lakes United, Lake Huron Alliance, Nature Conservancy, Federation of Ontario Naturalists and the National Wildlife Federation. Municipal authorities have an important role to play at the local level with respect to habitat.

<u>Do we have enough habitat information to derive environmental objectives?</u>

A great deal of habitat information is available, which is summarized in the next section. Participants thought that sufficient information exists at the present time to set environmental objectives for lake trout and whitefish. However, there is probably not enough information to develop objectives for nearshore, tributaries and upland areas. In particular, there is a need to understand linkages and interacting factors such as habitat preference and competition. There was some recognition that habitat is limiting in nearshore and tributaries, especially for achieving the Fish Community Objectives for percids, sturgeon and socids in St. Mary's River and Saginaw Bay.

If there is not enough information to define quantifiable objectives, some alternative approaches should also be considered. An intuitive approach to developing targets and identifying habitats could be used which is based on managers experience. Another approach is to set targets using information available in the literature and to refine this information using modelling. For some species, it would be possible to demonstrate the artificial costs of management options, such as stocking and hatchery operation, as compared to habitat restoration.

<u>Identified sources of habitat information in Lake Huron</u>

Much of the information about the open waters of Lake Huron is related to fish and fisheries data. There is fisheries data in the district files of state Departments of Natural Resources, commercial fishermen have anecdotal information about lake trout and whitefish spawning habitat, and there is an inventory of lake trout spawning shoals on the Canadian side of the lake compiled by Smith (1968) as well as a spawning atlas by Goodyear *et al.* (1982). A database called RESTOR, developed by Randy Eshenroder (GLFC), gives historical spawning areas and qualitative descriptions based on catches during spawning. Some sites are addressed in detail, such as the Saginaw Bay walleye reef inventory, which has been compiled by Dave Fielder (MI DNR, Alpena) and mapped on GIS, comprehensive GIS mapping which has been carried out by Parks Canada at Fathom Five Park and the quantitative spawning habitat information which is available for Yankee Reef and Six Fathom Bank.

Information about tributaries and shorelines is also fairly extensive. There is sea lamprey habitat information for many tributaries which have included collections of lamprey. Michigan's Water Quality division has at least two years of 'procedure 51' data on most tributaries for flow, substrate, macroinvertebrates and fish. On the Canadian side, the Ministry of Natural Resources has district records of stream surveys and Conservation Authorities develop watershed management plans. Particular tributaries have more information available from being part of a Remedial Action Plan process or as part of a power dam development. A shoreline sensitivity atlas compiled by Environment Canada contains information on substrate, sensitivity to spills, and maps of shoreline features. On the U.S. side, sensitive wetlands are being identified and considered through Coastal Zone Management and the Department of Environmental Quality's land and water management programs. Many shoreline areas have been mapped and dunes and coastal wetlands have been identified. Shoreline management plans have been developed for certain areas including the North Channel, Parry and Severn Sounds and Sault Ste. Marie. Finally, watershed assessments on 2 tributaries to Lake Huron, Au Sable and Flint, provide a habitat description and focus on fisheries management from a watershed perspective. The Canadian Wildlife Service has compiled an atlas of colonial waterbird nesting sites.

For the terrestrial component of Lake Huron's tributaries, there is also a great deal of available information. Much of the information is located at the offices of forestry companies or forestry agencies as part of the Forest Resource Inventory database which gives a

breakdown of amount and type of forest cover. Additionally, Michigan is monitoring global warming and looking at changes in jack pine forest on the Upper Peninsula based on satellite imagery. Soils, another feature of a watershed with the potential to affect aquatic habitat, is being mapped by the NRCS and Environment Canada.

Next Steps

Participants recommended that a workshop approach which involved all the pertinent user groups would be the best way to start the process of forming lakewide objectives. Through the workshop or series of workshops, the status of habitat would be defined. Ecosystem components as well as habitat objectives and targets would be identified. Data on each component must be amalgamated and then brought together to provide an idea of the larger picture. It may be appropriate to synthesize this information by watershed. A separate scoping meeting will be needed to specifically address formulation of ecosystem objectives.

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Workshop Definitions and Acronyms

The following definitions were intended specifically for use at the HABITAT 2001 Workshop, as these terms may have different definitions in other contexts.

Ecosystem Objectives: Ecosystem objectives are statements which reflect the desired future condition of the ecosystem to be attained and maintained. These statements can include specific descriptions of the desired state of the biological, chemical and physical components of the ecosystem, and may be based on restoration of impaired beneficial uses.

Water Use Goals: Water Use Goals are objective statements developed by each Public Advisory Committee for their specific Area of Concern, as part of the Remedial Action Plan process. They reflect the stakeholders desires for future conditions within the AOC which will indicate that beneficial uses have been restored.

Fish Community Objectives: FCO's are goal statements identified for components of the fish community in each of the Great Lakes. They are generally qualitative but can incorporate quantitative targets where there is sufficient information to support such a target. Lake Committees were directed to prepare FCO's using a strategy of consensus under the Joint Strategic Plan for Management of Great Lakes Fisheries, signed in 1981 by all of the fisheries management agencies on the Great Lakes.

Environmental Objectives: Environmental objectives are specific targets (ranges or end points) for physical and chemical attributes (e.g. nutrient loadings, contaminant loadings, habitat availability and habitat quality), that are necessary in order to achieve Fish Community Objectives.

Indicators: Indicators are factors that can be monitored to determine the effectiveness of a particular measure or suite of measures (eg. management actions, legislation etc.).

The following list outlines some of the common acronyms used throughout the workshop proceedings:

AOC	Area of Concern (an area identified by the International Joint Commission as a place where water uses are impaired and/or where objectives of the Great Lakes Water Quality Agreement or other environmental standards are not met)
CA	Conservation Authority (Canada)
COTFMA	Chippewa/Ottawa Treaty Fishery Management Authority
DDT	Dichlorodiphenyltrichloroethane (a pesticide, formerly widely used but now banned in the U.S. and Canada after it was linked to a number of severe environmental impacts)
DEQ	Department of Environmental Quality (United States)
DFO	Department of Fisheries and Oceans (Canada)
DNR	Department of Natural Resources (United States)
FCO	Fish Community Objectives
FCTC	Fishery Commission Technical Committee (a committee which addresses technical issues in Lake Michigan for the Great Lakes Fishery Commission)
GIS	Geographic Information System
GLFC	Great Lakes Fishery Commission
GLWQA	Great Lakes Water Quality Agreement
LaMP	Lakewide Management Plan
LSC	Lake Superior Committee of the Great Lakes Fishery Commission

LSTC	Lake Superior Technical Committee (a committee of experts which advises the Lake Superior Committee (LSC) on scientific and technical fishery issues)
MISA	Municipal - Industrial Strategy for Abatement (a program which controls and reduces the amount of toxic contaminants in industrial and municipal effluents that are discharged into Ontario's surface waters)
MOEE	Ontario Ministry of Environment and Energy
NGO	Non-governmental Organization
NRCS	Natural Resource Conservation Service (United States)
NTS	National Topographic System
OMNR	Ontario Ministry of Natural Resources
PAC	Public Advisory Committee
PCBs	Polychlorinatedbiphenyls (a group of chemicals of varying toxicity which are used in the production of lubricants, inks and electrical transformers)
RAP	Remedial Action Plan (a plan which is developed with citizen participation with the goal of restoring and protecting water quality in a particular area of concern (AOC) in the Great Lakes)
SGLFMP	Joint Strategic Plan for Management of Great Lakes Fisheries (1981)
SOLEC	State of the Lakes Ecosystem Conference
TCC	LaMP Technical Committee (a group of agency representatives from various government agencies in Michigan who work together to develop a Lakewide Management Plan)
USACOE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

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