

*Strategic Vision of the
Great Lakes Fishery Commission
for the First Decade
of the New Millennium*



The Great Lakes Fishery Commission was established by the *Convention on Great Lakes Fisheries* between Canada and the United States, which was ratified on October 11, 1955. It was organized in April 1956 and assumed its duties as set forth in the Convention on July 1, 1956. The Commission has two major responsibilities: first, to develop coordinated programs of research in the Great Lakes, and, on the basis of the findings, to recommend measures which will permit the maximum sustained productivity of stocks of fish of common concern; and second, to formulate and implement a program to eradicate or minimize sea lamprey populations in the Great Lakes. The Commission is also required to publish or authorize the publication of scientific or other information obtained in the performance of its duties.

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A C K N O W L E D G M E N T S

The Commission acknowledges the valuable contributions to this document from former commissioners Burton Ayles, David Balsillie, and David Dempsey. We are also indebted to those who provided comments on earlier drafts.

September, 2001

COVER PHOTOS: S. CAMAZINE, M. GADEN

The fish on the front cover is one of the first naturally produced lake trout recovered from Lake Ontario, taken from Stony Island reef, April 18, 1986. For more information about this fish, see Marsden et al. (1988) Evidence of Natural Reproduction by Stocked Lake Trout in Lake Ontario. *Journal of Great Lakes Research* 14(1): 3-8.

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GREAT LAKES FISHERY COMMISSION
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*“One of the major challenges facing
all the peoples of the world today remains
as it was a century ago: to save the fish.”*

— Margaret Beattie Bogue
Fishing the Great Lakes

Strategic Vision of the Great Lakes Fishery Commission for the First Decade of the New Millennium



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PHOTO: MARC GADEN

EXECUTIVE SUMMARY

The context for achieving sustainable fisheries in the Great Lakes has evolved in recognition of changes in ecosystem complexity and stakeholder expectations. This Strategic Vision of the Great Lakes Fishery Commission reflects these changes and is a revision of its predecessor. Like its predecessor, this Strategic Vision serves to guide the development of Commission programs and to communicate their intent and purpose. It provides an explicit statement of the focus and direction of Commission programs from 2001 through 2010 and renews the Commission's conviction that an ecosystem approach is essential for successful management of the Great Lakes. A key part of this approach requires that existing relationships must be strengthened and new partnerships must be forged between the Commission and its stakeholders—if the challenges of the future are to be surmounted. The Strategic Vision is composed of specific statements covering three areas:

1. Healthy Great Lakes Ecosystems
2. Integrated Management of Sea Lamprey
3. Institutional/Stakeholder Partnerships

Each vision statement has equal priority and should be interpreted within the context of the other two vision statements and the ecosystem concept. Each statement is supported by a set of milestones that describe important, measurable events that will occur by designated dates if the Commission successfully achieves its Strategic Vision. The Commission will conduct a review and provide a report to its partners on achievement of milestones and vision statements by June 15, 2005, and June 15, 2011.

The vision statements are:

1. Healthy Great Lakes Ecosystems

The Commission shall encourage the rehabilitation and conservation of healthy aquatic ecosystems in the Great Lakes that provide sustainable benefits to society, contain predominately self-regulating fish communities, and support fisheries with increasing contributions of naturally reproducing fish. Conserving biological diversity through rehabilitation of native fish populations, species, communities, and their habitats has a high priority.

2. Integrated Management of Sea Lamprey

The Commission will provide an integrated sea lamprey management program that supports the Fish Community Objectives for each of the Great Lakes and that is ecologically and economically sound and socially acceptable.

3. Institutional/Stakeholder Partnerships

The Commission will encourage the delivery of complementary programs focused on healthy Great Lakes ecosystems and integrated management of sea lampreys through

- leadership from the Lake Committees in development and pursuit of Fish Community Objectives,
- coordination of fish management programs,
- development of coordinated research programs,
- recognition of Fish Community Objectives by environmental agencies as these agencies implement their programs, and
- strengthened and broadened partnerships among fish management agencies, environmental agencies, and non-agency stakeholders.



PHOTO: D. KENYON, MI DNR

INTRODUCTION

Background

The indigenous fishes of the Great Lakes have greatly changed since the arrival of the first European settlers. Rapidly expanding fisheries, extensive degradation of aquatic habitats, and the invasion of alien species, such as the sea lamprey, have profoundly reduced the historical diversity of native fishes and the fisheries they supported. Many of these losses were poorly documented in the literature of the day, but the available descriptions indicate that losses from lakes Erie and Ontario, the first lakes to be settled, were already recognized by the early 1800s. More devastating losses were yet to come, and they would extend to lakes Superior, Michigan, and Huron. By the start of the 20th century,

- Atlantic salmon were gone from Lake Ontario;
- two deepwater ciscoes were nearly extinct in lakes Michigan and Huron;
- lake sturgeon were threatened in all of the lakes and extinguished in some areas;
- fish that used large rivers for spawning were greatly diminished in all of the lakes.

Transformation of the fish communities and their associated fisheries continued unabated into the middle of the 20th century. By this time, non-native fishes, the alewife and rainbow smelt, dominated the deepwater community and had largely replaced the native ciscoes. Lake trout, the native top predator within the deepwater community, was being pushed toward local extinction by over-fishing and the predacious, non-native sea lamprey. The shallow-water community, although less directly affected by the sea lamprey, also was transformed during this period. By 1960, the blue pike, the mainstay of the Lake Erie fishery, was near extinction, and the walleye, the next most-valuable fish



Indians spearfishing by torchlight. Sketch by Paul Kane. London: Longman, Brown, Green, Longmans and Roberts, 1859.

PHOTO: ROYAL ONTARIO MUSEUM



Collingwood Harbor, Ontario, 1870. Mackinaw boats.

PHOTO: WISCONSIN MARITIME MUSEUM



PHOTO: BURTON HISTORICAL COLLECTIONS, DETROIT PUBLIC LIBRARY

Pound net boat (far left) and trap net boats, Caseville, Michigan, 1920s.

PHOTO: BURTON HISTORICAL COLLECTION, DETROIT PUBLIC LIBRARY



in the lake, was headed toward population collapse. Much of the fishing industry disappeared because the non-native species that replaced the native fishes were low in value.

The invasion of the sea lamprey into the upper Great Lakes and the associated collapse of lake trout populations served as a catalyst for action by federal, provincial, and state fishery management agencies. Stocking, sea lamprey control, fishery regulation, and water-quality management were actions taken to help restore the fisheries. In response to these actions, a period of remarkable recovery of the fisheries began in the late 1950s. Lake trout populations in Lake Superior were rebuilt with hatchery plantings and protected from sea lampreys through chemical suppression of their stream-living larvae; subsequently these efforts were extended to the other four lakes. By the 1980s, stocked rainbow, lake, and brown trout and Pacific salmon together had curtailed the alewife and smelt populations and supported very popular and growing recreational fisheries. Upswings in populations of lake whitefish, deepwater ciscoes, yellow perch, and walleyes accompanied the buildup of trout and salmon populations. During this era of recovery, fisheries were regulated more effectively than they had been in the past. At the same time, stricter regulation of pollutants, including toxic substances, resulted in cleaner water—a response to the *Great Lakes Water Quality Agreement*. This turnaround in the fisheries from the 1950s to the mid 1980s was an extraordinary achievement.

During the late 1980s, the Great Lakes fishery entered another ominous period of disruption. Some of the successes of the past faltered. The first setback was a reduction of Pacific salmon abundance in lakes Michigan and Ontario caused by declining food resources. In addition, survival rates of stocked fish of other species were declining throughout the Great Lakes. Then, natural recruitment of ciscoes and yellow perch fell sharply in the upper Great Lakes for unexplained

Sturgeon once supported a large commercial fishery on the Great Lakes. Today, sturgeon rehabilitation is a key priority for management agencies. PHOTO: WI DNR



reasons. Simultaneously, new non-native species became established, and they, like the sea lamprey, threatened fundamental changes in the fish communities and the fisheries. Finally, the overall productivity of the Great Lakes appeared to be declining due to reduced inputs of nutrients. Reduced productivity translated to reduced catches.

Confidence in the sustainability of the revitalized fisheries of the 1970s and 1980s weakened during the 1990s. Especially alarming was a major restructuring of food webs in the lower Great Lakes where aggressive non-native species, introduced via ballast water from ocean-going ships, displaced important native species. Proliferation in Lake Erie of zebra and quagga mussels disrupted the pathway of energy flow from invertebrates to fish. Other new invaders, both invertebrates and fish, also distorted food webs in the lower lakes and began to spread to the upper lakes. This new wave of non-native species is expected to dramatically affect fish communities. Economically important fish such as whitefish, trout, and salmon appear most vulnerable. The rapid and unpredictable changes now occurring in the Great Lakes present formidable challenges for fishery management. What form the fish communities and their fisheries will take during the next decade is difficult to forecast.

Species invasions, ecosystem changes, and declining fisheries are not new challenges to Great Lakes fishery management. The *Convention on Great Lakes Fisheries*, signed by Canada and the U.S. in 1954, was a recognition by governments of the need to end the fishery losses made vivid by the invasion of sea lampreys and the resulting collapse of lake trout populations in the upper Great Lakes. The framers of the Convention realized that joint and coordinated efforts from both countries were essential to sustain fishery productivity in the Great Lakes. To bring about these efforts the Convention established the Great Lakes Fishery Commission and charged it with five general duties (from the Convention):

- (a) *to formulate a research program or programs designed to determine the need for measures to make possible the maximum sustained productivity of any stock of fish in the Convention Area which, in the opinion of the Commission, is of common concern to the fisheries of the United States of America and Canada and to determine what measures are best adapted for such purpose;*
- (b) *to coordinate research made pursuant to such programs and, if necessary, to undertake such research itself;*



Representatives from Canada and the United States who negotiated the *Convention on Great Lakes Fisheries* in 1954-1955.

- (c) *to recommend appropriate measures to the Contracting Parties on the basis of the findings of such research programs;*
- (d) *to formulate and implement a comprehensive program for the purpose of eradicating or minimizing the sea lamprey populations in the Convention Area; and*
- (e) *to publish or authorize the publication of scientific and other information obtained by the Commission in the performance of its duties.*

In addition to the control of the sea lamprey in the Great Lakes basin, improved coordination among fishery management agencies has been a continuing goal of the Commission since its first meeting in 1955. Even though various committees were already working on sea lamprey control, rehabilitation of lake trout, and other problems when the Commission was formed, these groups soon elected to work under the aegis of the Commission. Initially, the Commission guided lake trout rehabilitation efforts in the upper Great Lakes, but the need to address a wider range of issues led to the establishment of Lake Committees in 1966. Five Lake Committees were established—one for each Great Lake; each committee was composed of one representative from each fishery management authority. Lake Committees were charged with developing inter-jurisdictional management policy and reporting annually to the Commission.

During their first 15 years, Lake Committees worked essentially on an *ad hoc* basis without an established framework for guiding management actions among jurisdictions. This organizational deficiency became apparent in the late 1970s when U.S. legislation provided for the development of fishery management plans by coastal and Great Lakes states. The Commission, in concert with

federal, provincial, and state natural-resources agencies, adopted in 1981 *A Joint Strategic Plan for Management of Great Lakes Fisheries* as an explicit statement on cooperative fishery management for the Great Lakes. The signatory agencies were those with legislated mandates for Great Lakes fisheries. In 1989, two tribal organizations in the U.S. adopted the Joint Strategic Plan and became signatory agencies.

The context for achieving sustainable fisheries in the Great Lakes has evolved in recognition of changes in ecosystem complexity and stakeholder expectations. The Joint Strategic Plan commits the Commission to provide a forum for the signatory agencies to take action. Partnerships, both those identified in the Joint Strategic Plan and those with other agencies and the public, are required now to meet the challenges of managing the Great Lakes as whole ecosystems. Public interest in Great Lakes policy was much greater in the 1990s when fisheries faltered than it was in the 1980s when salmon fisheries boomed. The increased complexity of ecological problems paralleled the increase in complexity of stakeholder arrangements, creating greater demands for joint and coordinated actions by the Commission. These demands, coupled with differing perceptions regarding its role, caused the Commission in 1992 to formally communicate its philosophy and goals. This document, a *Strategic Vision of the Great Lakes Fishery Commission for the Decade of the 1990s*, consisted of a statement of purpose, a fundamental concept, and three vision statements each with milestones and supporting rationales.

The Strategic Vision helped to clarify the role of the Commission in fishery management. Here the Commission reaffirmed support for the agreed-upon actions of the Lake Committees as described in the Joint Strategic Plan, but also provided for specific ecological objectives not necessarily identified by Lake Committees. These ecological objectives follow from Article IV of the Convention, which charges the Commission to determine measures that are best adapted for making possible maximum sustained yield for fish species of common concern. This same article does not give the Commission fishery management authority, except for sea lamprey control, but it does provide for formulating and communicating management needs for fishes of common concern. Strategic Visions are one method used by the Commission to document and advocate what it hopes will be accomplished for Great Lakes fisheries. Changes in Great Lakes ecosystems and achievement of many of the milestones in the original Strategic Vision necessitated an update in anticipation of the coming decade.

The Commission's *Strategic Vision for the First Decade of the New Millennium* was developed to support the Convention and the Joint Strategic Plan and is a revision of the original Strategic Vision. This vision, like its predecessor, serves to guide the development of Commission programs and to communicate their intent and purpose. The primary audiences for this document are the cooperating fishery agencies, the Canadian and U.S. Advisors representing key stakeholder groups, the Parties to the Convention (the two federal governments), and the Commission itself. Moreover, cooperating agencies will find the Strategic Vision useful for explaining to their stakeholders how inter-jurisdictional fisheries management is conducted on the Great Lakes. Vision statements, coupled with milestones, offer a clear, concise statement to the Parties to the Convention as to where the Commission believes the Great Lakes fisheries and their management should be moving at the start of the new millennium.

Purpose and Organization

This document describes the focus and direction of Commission programs through the year 2010. When the Commission wrote its Strategic Vision for the decade of the 1990s, the ecosystem approach was a unifying concept. Indeed, the ecosystem concept remains fundamental to this document and provides the foundation for three vision statements:

1. Healthy Great Lakes Ecosystems
2. Integrated Management of Sea Lamprey
3. Institutional/Stakeholder Partnerships

Each vision statement has equal priority; each should be interpreted within the context of the other two vision statements and the ecosystem concept. Each statement is supported by a set of milestones that describe important, measurable events that will occur by certain dates if the Commission successfully achieves its Strategic Vision. Milestones were chosen based on their importance as indicators and their ease of measurement. Their order of presentation does not imply order of priority. Instead, milestones described within a vision statement should be viewed in the aggregate with a high priority assigned to each. Milestones are to be achieved before the end of the year 2010, unless otherwise specified.

This document describes what the Commission desires as a future state for the Great Lakes. It does not include an operational plan that explains the type of

actions the Commission will encourage or use to achieve each vision statement. Actions taken by the Commission will vary depending on the particular vision statement. For example, the Commission will function primarily as a facilitator among natural-resources agencies to accomplish the ecosystem and partnership vision statements and rely heavily on the cooperation and coordination efforts of these agencies. This approach is in contrast to the more direct role the Commission exercises with the sea lamprey management program. The Commission has direct authority over certain program elements as mandated by the Convention, but cooperation with other agencies remains essential in meeting these responsibilities. As foreseen in the Convention, the Commission will continue to work with a variety of organizations, public and private.

The greatest value of this document will be to the Commission itself. First, experience with the original Strategic Vision revealed that it greatly aided Commission decision-making. As issues were discussed, a key question asked was “Will a proposed decision impede or enhance progress towards milestones and vision statements?” The Commission intends to continue addressing decisions in this way. Second, by using a uniform set of decision criteria, Commission programs will be consistent, complementary, and not contradictory. The Strategic Vision offers a framework to ensure that decisions, often made incrementally, are logically connected and support progress toward specified goals. The vision statements, coupled with measurable milestones, will ease evaluation of Commission programs. Regular evaluation will provide essential feedback of information to guide program redirection or correction. The Secretariat of the Commission will provide annual reports to the Commission concerning progress towards achieving the Strategic Vision. The Commission will conduct a review and provide a report to its partners on achievement of milestones and vision statements by June 15, 2005, and June 15, 2011.



PHOTO: VERIDIAN (FORMERLY ERIM)

Fundamental Concept

The Commission adopts and advocates an ecosystem approach to management and research of Great Lakes fishes.

The ecosystem approach to decision making recognizes the interconnection between the air, land, and water in the Great Lakes basin and the welfare of its inhabitants. All components of the ecosystem (such as nutrients, primary production, forage fish, predatory fish, habitat, chemical contaminants, climate, and human use) interact with each other and, therefore, must be considered in terms of their system-level effects. This approach is consistent with the *Convention on Great Lakes Fisheries*, the *Great Lakes Water Quality Agreement*, and *A Joint Strategic Plan for Management of Great Lakes Fisheries*.

The ecosystem approach is well suited to address complex problems with extensive linkages such as introductions of unwanted, non-native species; toxic chemicals in fish; and non-point pollution sources. The ecosystem approach broadens the Commission’s concept of the “beneficiaries of management” from commercial, subsistence, and recreational fishermen to stakeholders (clients plus potentially all others in the Great Lakes basin and some beyond). It also implies a broad spirit of cooperation without which the aspirations emphasized in this document could not be achieved. The three vision statements that follow were developed based on this concept.



VISION STATEMENT ON HEALTHY ECOSYSTEMS

The Commission shall encourage the rehabilitation and conservation of healthy aquatic ecosystems in the Great Lakes that provide sustainable benefits to society, contain predominately self-regulating fish communities, and support fisheries with increasing contributions of naturally reproducing fish. Conserving biological diversity through rehabilitation of native fish populations, species, communities, and their habitats has a high priority.

Milestones

1. Conserve native biodiversity
 - Native fish species will not be lost from any Great Lake.
 - Rehabilitation plans will be formulated for extirpated deepwater fishes by 2004.
 - Rehabilitation of lake trout will be achieved throughout Lake Superior and in Lake Huron's Georgian Bay, and naturally reproduced juvenile lake trout will increase in abundance elsewhere in the Great Lakes.
2. Prevent invasion of non-native fishes
 - No non-native fishes will be unintentionally introduced in the Great Lakes.
3. Increase natural recruitment
 - Natural reproduction will contribute a minimum of 50% of adult trout and salmon available for harvest from each lake.

4. Improve habitat
 - Gains and losses of aquatic habitats will be classified and inventoried in a comprehensive manner for each Great Lake.
 - An interagency effort to protect critical habitats and restore other habitats will be organized and begun.
 - An action plan that reviews past roles and policies regarding toxic substances and that identifies new ways for the Commission to interact with other agencies to achieve reductions will be developed by 2003.
5. Gain new information

The Board of Technical Experts by 2002 will initiate research that

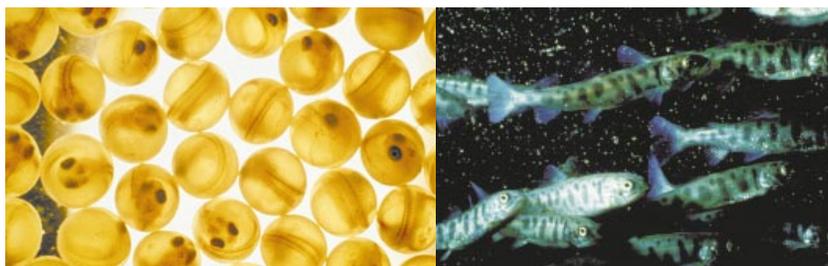
 - assesses causes of change in Great Lakes fish communities,
 - provides a workable method for detecting gains and losses of critical Great Lakes habitats by 2005,
 - identifies the degree to which toxic substances and diseases together have influenced fish populations, and
 - establishes a forum for intercontinental exchange of information on issues affecting large lakes.

Rationale for the Ecosystem Vision Statement



Great Lakes fishery management became more complex during the decade of the 1990s. Much of the fishery remained dependent on hatcheries, losses of aquatic habitat continued, and a second wave of non-native nuisance species spread through the lakes. The number of management entities increased as more aboriginal peoples confirmed their fishing rights, while pressure from users for short-term solutions intensified. The Commission's vision statement on healthy ecosystems and its supporting milestones emerge from and respond to this milieu of uncertainty and change.

PHOTO: C. KRUEGER



Lake trout eggs and fry. PHOTOS: AMERICAN FISHERIES SOCIETY

Conserve native biodiversity

The conservation of biodiversity has two objectives: prevention of further losses and rehabilitation of native species and their diversity. Several endemic fishes were exterminated from the Great Lakes by the early 1960s. These losses included two species of deepwater ciscoes and the blue pike. The extinction of the shortnose cisco, a deepwater fish once abundant in three of the Great Lakes and last seen in 1975, demonstrates that the problem of irreversible loss has not been solved. The Commission believes that efforts should be made to reintroduce remaining native fishes, particularly those that inhabit deepwater. These fishes, ciscoes, lake trout, and sculpins, are specialized for the Great Lakes and can fill missing links in food webs now only marginally occupied by other species. Their reestablishment would provide an enriched community characterized by more-stable fisheries. Emphasis on deepwater fishes does not minimize the importance of rehabilitating shallow-water forms such as the coaster brook trout.

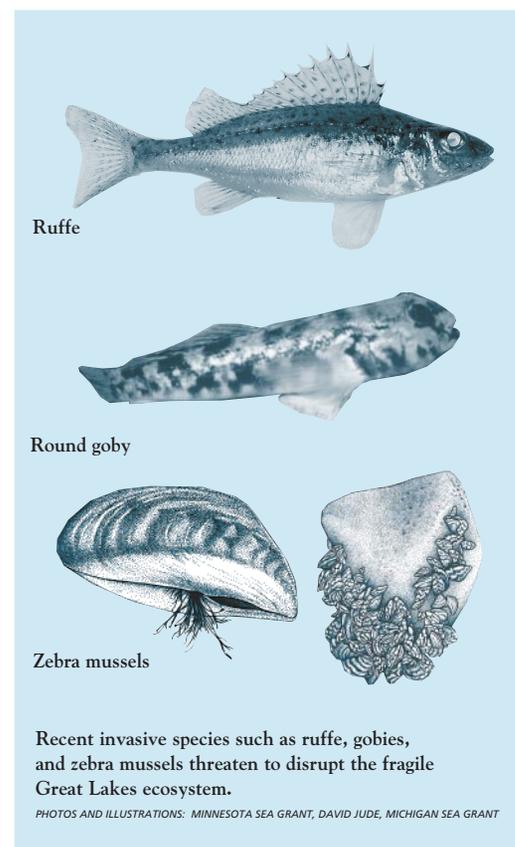
The lake trout, a species whose loss led to the formation of the Commission, has been nearly restored to Lake Superior after a four-decade-long effort. Success in the other lakes, however, remains elusive except in Georgian Bay where a modest recovery is underway. The Commission believes that the Great Lakes cannot be considered healthy until this species and its natural diversity of forms become self-sustaining in each lake. Lake trout had formerly occupied the lakes from shore to shore and to the greatest depths; no other species has assumed its ecological role. The Commission has aggressively supported research aimed at identifying the impediments to lake trout rehabilitation and will continue to do so in the next decade.

Prevent invasion of non-native species

Non-native species have arguably been more destructive to the native fish fauna of the Great Lakes than any other single force. Construction of canals and intentional introductions allowed the first wave of invaders into the lakes. A

new, rapidly spreading, second wave of invading species is associated with ballast-water discharges from ocean-going vessels. The worst of these invaders—quagga and zebra mussels, predacious zooplankton species, and round gobies—have the potential to profoundly alter food webs once they fully colonize the Great Lakes. Unwanted non-native fish and other organisms can also gain entry via the private culture of food fishes and via the aquarium and bait industries. Some introduction of non-native organisms for natural pest control, as with a recent attempt to control purple loosestrife with non-native beetles, may be beneficial when strictly and carefully implemented.

Preventing entry is the only solution to the invasive-species problem. Aside from exceptional circumstances when a net benefit to both ecosystem health and native species can be clearly established, no organism should be introduced into the Great Lakes basin. Most invaders, once established, are impossible to control. Even when their populations are curtailed, non-native species, such as the alewife, may still disrupt food webs in novel ways. For example, excessive consumption of alewives causes a widespread reproductive impairment in predators called early mortality syndrome. Effective safeguards against invasions require a strong and long-term commitment from gov-



Ruffe

Round goby

Zebra mussels

Recent invasive species such as ruffe, gobies, and zebra mussels threaten to disrupt the fragile Great Lakes ecosystem.

PHOTOS AND ILLUSTRATIONS: MINNESOTA SEA GRANT, DAVID JUDE, MICHIGAN SEA GRANT

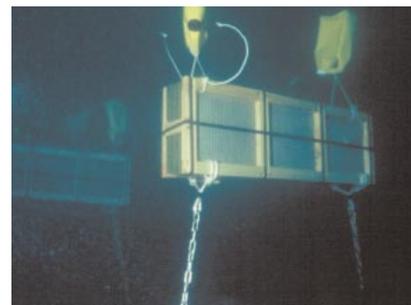
ernments and advocacy groups. Safeguards for fish, the focus of this milestone, will also diminish the likelihood that other organisms will invade the Great Lakes. The Commission, therefore, will intensify its work with partners to implement those safeguards that apply to vectors, such as ship ballast water, which pose the greatest risk to the Great Lakes.

Increase natural recruitment

The Commission views sustainable fisheries as the primary goal of fishery conservation and views fishery conservation as protecting and restoring the connections between fish and other aquatic organisms and their environment. Natural recruitment failure resulting in the loss of a fishery represents a severing of these connections, either because of a loss of adult fish and their ability to produce fertile eggs or because of a loss of habitat, particularly reproductive or nursery habitats. Fish hatcheries in the Great Lakes have partially replaced natural fish recruitment, but stocked fish alone do not solve the causes of failed natural reproduction. Propagating fish in hatcheries interferes with the selection pressures that the natural environment exerts on fish throughout their life cycles and ultimately makes cultured fish less competitive in the wild. The difficulty of artificially maintaining fish populations for long periods of time is now better understood because of advances in behavioral and genetic research and in the ecology of fish diseases. Fish hatcheries, however, are required to rehabilitate seriously depleted fishes in the Great Lakes, such as the lake trout, and to

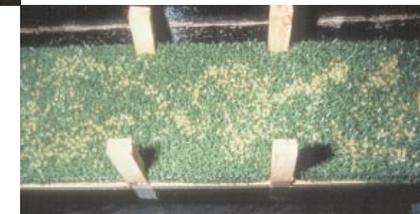
Fish hatcheries provide top predators and fishing opportunities.

PHOTOS: C. KRUEGER



New approaches to stocking early life stages, like these Astroturf bundles for stocking the egg stage of lake trout, may improve the fitness of fish introduced for restoration.

PHOTOS: WIDNR



rear predators, such as salmon, that are needed to suppress non-native fishes that become pests when overly abundant. Stocking also provides for important fisheries, particularly those near urban areas.

Stocked fish have contributed to the remarkable recovery of lake trout over large areas of Lake Superior and have resulted in Pacific salmon becoming naturalized in many Great Lakes tributaries. Rehabilitation and naturalization have made fish communities more self-regulating by reestablishing natural controls between prey fishes and their predators. Community regulation works best when recruitment of predators and prey fishes responds freely to environmental variation. Controlling predator numbers by adjusting hatchery production is too unresponsive to environmental variation and too vulnerable to political pressure, and thus is likely to over- or under-shoot actual ecosystem requirements. The Commission recognizes the need to continue the stocking of top predators, but reiterates its philosophy that self-sustaining fish populations are the long-term solution and that opportunities for increased natural recruitment should be favored over increased opportunities for hatchery-based fisheries, when the two approaches conflict. Naturally reproducing fish populations offer the best prospects for maintaining sustainable production of trout and salmon in the Great Lakes. Although the 50% (minimum) natural-reproduction milestone for trout and salmon will be difficult to achieve in all five lakes, the Commission sees this milestone as an essential attribute of a healthy ecosystem.

Improve habitat

Losses of physical habitat critical to fish and other aquatic organisms continue in the Great Lakes even though governments regulate development of Great



Brule River, Wisconsin. PHOTO: C. KRUEGER

Lakes shorelines and river flood plains. Much aquatic habitat, just like the fish that depended on it, vanished in the 1800s before it was inventoried or its value understood. Clearly, those aquatic habitats whose supply has been most diminished are now all the more valuable owing to their scarcity. Problems of protection and rehabilitation appear nearly insurmountable because of a diffuse regulatory structure and an absence of ability to report loss in relation to supply. Rivers are particularly hard to protect because development of uplands, well away from floodplains, affects hydrologic cycles that control fish composition and abundance. The Commission strongly endorses a goal of no loss of critical fish habitat; this goal, however, cannot be achieved until a comprehensive system of classification and inventory is in place on each Great Lake. The milestone on classification and inventory recognizes this need and commits the Commission to the development and implementation of the required system. Because of the enormity of this task, first priorities for classification and inventory should be given to vegetated near-shore areas and to rivers, especially those rivers less altered and still supporting assemblages of native fishes. The milestone on organizing and initiating an interagency effort to protect and restore habitats logically flows from the preceding milestone on classification and inventory. The Commission understands that developing a workable system of classification and inventory and getting environmental regulators to then use it is a very ambitious undertaking. Nonetheless, the achievement of this second milestone is critical for preventing further loss of critical habitats.

Chemical degradation of aquatic habitats in the form of persistent toxic substances remains a problem in the Great Lakes. Acute (lethal) effects of toxics on fish appear to be less of a problem than chronic (sub-lethal) effects.

Potentially serious sub-lethal effects include interactions among toxics such as synergistic effects, and other maladies such as estrogenic effects and fish diseases. The chronic effects of toxics on wildlife have become better understood during the last decade and certain fish-eating birds, reptiles, and mammals are especially sensitive. Fortunately, the impacts on wildlife have decreased as overall levels of toxic substances declined in response to controls imposed in the 1970s. The effects on humans from consuming contaminated fish continue to be researched extensively. Some Great Lakes fishes are contaminated sufficiently that human consumption is not advised, especially for certain risk groups such as women of child-bearing age. Recreational and commercial fisheries can be devastated by consumption advisories or prohibitions on marketing that apply to one fish species and area but that then taint the public's image of all Great Lakes fishes. The Commission has no regulatory role to deal directly with problems concerning toxics, but it can influence those agencies that do. To achieve reductions, the Commission will undertake a review of its past role and policies regarding toxic substances and develop an action plan that identifies new ways for the Commission to interact with other agencies.

Gain new information

The Commission sees healthy ecosystems as valuable in their own right and as a means to an end—sustainable fisheries for the enjoyment of future generations. Naturally reproducing fish populations, fish communities diversified with reintroduced native fishes, no new aquatic nuisance species, no loss of critical aquatic habitats, and reduced toxic substances are viewed as the foundation for a sustainable fishery. New information will be needed to accomplish this vision and its milestones. The Commission's Board of Technical Experts will itself undertake and also will encourage its partners to collaborate on the related



New York Department of Environmental Conservation research vessel *Seth Green*.

PHOTO: C. KRUEGER

research. Human disturbances—over-fishing, introduced species, and habitat degradation—are ultimately responsible for almost all of the recognized impairments to Great Lakes fish communities. How these ultimate causes cascade through and disrupt communities is poorly understood. Information on interactions among species and between species and their environment is needed if managers are to anticipate changes. Therefore, important areas of research will examine how large-scale disturbances such as climate change influence lake levels and fish communities, which Great Lakes habitats are priorities for rehabilitation, and how toxic substances and fish diseases such as early mortality syndrome interact. Learning from other large-lake systems also will be a key strategy used to advance our own understanding of Great Lakes ecosystems. The challenge to use new information to achieve healthy Great Lakes ecosystems is large and will require coordinated and cooperative efforts among the many federal, provincial, state, and tribal agencies and their non-governmental partners. Agencies will need to be flexible in the design and implementation of their programs to attain sustainable fisheries and a healthy Great Lakes ecosystem. The Commission's own program of sea lamprey control must also be carefully coordinated with other fishery agencies and is the focus of the next vision statement.



VISION STATEMENT ON INTEGRATED MANAGEMENT OF SEA LAMPREY

The Commission will provide an integrated sea lamprey management program that supports the Fish Community Objectives for each of the Great Lakes and that is ecologically and economically sound and socially acceptable.

PHOTO: USFWS

Milestones

1. Achieve economic injury levels
 - Suppress sea lamprey populations to economic-injury levels (maximize net benefits of sea lamprey and fishery management) by the year 2005.
2. Control the St. Marys River
 - Suppress sea lamprey populations in the St. Marys River to a level that allows rehabilitation of lake trout in northern Lake Huron.
3. Use alternative control technologies
 - Accomplish at least 50% of sea lamprey suppression with alternative technologies while reducing TFM use by 20% through
 - use of at least one new alternative-control method,
 - increased use of current methods such as sterile-male-release, trapping, and barrier deployment.
4. Estimate recruitment
 - Estimate recruitment of sea lampreys from all sources, including non-treated rivers, estuaries, and connecting channels, by 2005.



Brown trout with sea lamprey wound.
PHOTO: J. STOPKE

Rationale for the Sea Lamprey Vision Statement

Continued suppression of sea lampreys is essential to achieve healthy aquatic ecosystems in the Great Lakes. This pest fish has proven itself to be remarkably persistent in the Great Lakes despite long-term control efforts mainly with lampricides applied in nursery streams. Control, however, has severely reduced sea lamprey population sizes. In 1982 the Commission adopted a policy embracing an integrated-pest-management approach, and since then the focus of control has been on reducing sea lamprey populations to tolerable levels rather than on eradicating them. Of the causes of death that affect adult salmon and trout, the mortality caused by sea lampreys and by fisheries are direct outcomes of management. A major challenge for the Commission, therefore, has been to determine a level of control for each lake that complements fishery management.

Achieve economic-injury levels

Integrated pest management is based on setting target population levels for the pest species. This target, termed an economic-injury level, reflects a trade-off between the costs and benefits of control. Benefits include the economic, social, and ecological values of fish saved from sea lamprey predation. Costs include expenditures for control and environmental costs such as mortality of non-target organisms during stream treatments and the degradation of habitat associated with construction of lamprey-spawning barriers.

The original Strategic Vision called for establishment of target numbers of sea lampreys for each Great Lake by 1994, but this milestone was not achieved. Estimation of the benefits of control, particularly the value of fish saved, is the remaining impediment. The relationship between the amount of control effort directed at larval sea lampreys and the number of fish killed by surviving sea lampreys has been established. Maintaining reliable estimates of the

The Great Lakes fishery is an important economic draw to the region.

PHOTOS: C. KRUEGER



The St. Marys River, which connects Lake Superior and Lake Huron, is prime habitat for sea lampreys. Ongoing sea lamprey control on the river requires the use of the sterile-male-release-technique, enhanced trapping, and granular Bayluscide. PHOTO: DFO

Control the St. Marys River

If Lake Huron is to once again become ecologically healthy, the sea lamprey population in the St. Marys River must be greatly reduced. The St. Marys River is the connecting channel between Lake Superior and Lake Huron and is by far the major supplier of juvenile (parasitic) sea lampreys to Lake Huron. The river presents special problems for control because it is 27 times larger (at low flow) than any other river treated previously with chemical lampricides. The most infested areas of the river were treated for the first time in 1999 with a specially formulated lampricide. In addition, sterile-male-release and trapping efforts were intensified before the treatment. Several years will be required to assess how larval reductions from this treatment translate into reduced numbers of sea lampreys in Lake Huron. The treatment goal is to suppress production of larval sea lampreys in the river to no more than 5% of their abundance in the mid 1990s. The ultimate goal is to allow for rehabilitation of lake trout in Lake Huron, a key fish community objective for the provincial, state, and tribal management agencies on the lake.



Low-head sea lamprey barriers prevent sea lampreys from reaching their spawning grounds. Once an effective sea lamprey barrier is constructed in a river, lampricide treatments are normally unnecessary above the barrier. Low-head barriers are usually equipped with devices to pass fish. PHOTOS: GLFC, A. HALLETT



Use alternative control technologies

The Commission began the decade of the 1990s with the objective of achieving a 50% reduction in the use of lampricides. Extensive tests on the environmental safety of the two lampricides used by the Commission, TFM and Bayluscide, have revealed no long-term, detrimental effects to the ecosystem. Nonetheless, public apprehension about pesticides and rapidly escalating lampricide costs compelled the Commission to find substitutes, even though stream applications continued to be remarkably successful. Several innovations in treatment methodology during the 1990s, and a strong commitment by the Commission's control agents, resulted in a 30% decline in use of TFM, the most commonly applied lampricide. Although the 50% target was not reached, the Commission was gratified with progress and remains committed to the full 50% reduction. Achievement of the balance of the 50% reduction, an additional 20%, will be challenging because the amount of TFM applied in a treatment cannot be reduced further without risking treatment effectiveness. Thus, the sought-after reductions in TFM use mean that fewer streams will be treated. This reality implies that deployment of existing and implementation of new alternative methods of control must be expanded to reach the overall 50% reduction in TFM use. Application of Bayluscide, now used sparingly, will remain low into the foreseeable future. Small amounts of Bayluscide mixed with TFM reduce the amount of TFM required to maintain its selectivity to lampreys, furthering the reduction in TFM use. For example, Bayluscide reduces the overall toxicity of lampricide treatments to the lake sturgeon, a species of concern, and to other important organisms. Also, Bayluscide is mixed with TFM at concentrations that are low enough not to be toxic to mollusks, even though Bayluscide was originally formulated

for snail control. Bayluscide may also be used to treat river mouths and to treat the connecting channels between the lakes, areas where TFM is ineffective.

Full-scale field deployment of one new alternative-control method is an important milestone of the Commission for the next decade. During the 1990s, the Commission accelerated the development of alternatives to lampricide-based control. One alternative, sterile-male-release, was implemented in



The sterile-male-release-technique is an important part of the GLFC's alternative sea lamprey control strategy. PHOTO: M. GADEN

the St. Marys River following field studies in Lake Superior. The most promising methods for future implementation involve the use of pheromones, chemical substances released by lampreys as signals to other lampreys. One pheromone, released by larval lampreys living in streams, signals to lake-dwelling adults that a stream is suitable for reproduction. A second pheromone, released by fully mature males, signals their sexual receptiveness to females. To increase the effectiveness of control, synthetic pheromones could be used to attract spawning adults into streams unsuitable for their offspring or to interfere with mate selection once adults are in streams.

Conventional alternatives, such as trapping of adults in streams and blocking their access to spawning grounds, remain important and will be intensified. The Commission's policy will be to build barriers only on stream sections where effects on native biodiversity do not exceed the benefits of reduced applications of lampricides. Barriers eliminate the need to treat streams or portions of streams, but they also may impair the upstream migration of other fishes. Barriers will be designed to minimize deleterious effects on non-target fishes. By the end of the decade, conventional and new alternative methods of control will account for 50% of the suppression of sea lamprey populations whereas the other half will be achieved with lampricides.

Researchers use a two-chambered raceway to determine whether sea lampreys are attracted to pheromones, sex attractants released by spawning sea lampreys. PHOTO: M. GADEN



Estimate recruitment

An important challenge to the control program is to determine whether feeding (parasitic phase) sea lampreys are survivors from already-treated nursery areas or instead are from untreated, possibly undiscovered, sources. Injury levels will only be met if all sources of these parasites are quantified. Some sea lamprey larvae migrate from streams into shallow bays near stream mouths where they are more difficult to assess and more costly to control. Larvae occur in other connecting channels such as the St. Clair and Niagara rivers, in addition to the St. Marys River. The importance of these recruitment sources is unknown. However, before control is implemented in a new area, population estimates of sea lamprey will be required to determine whether more suppression is warranted. Quantifying how much juvenile recruitment comes from non-treated rivers, estuaries, and connecting channels and how much comes from already-treated streams must be answered. Recognizing the importance of this question, fishery agencies and stakeholders in recent years have assisted the control agents in estimating recruitment. Their efforts will continue to be important for

achievement of this milestone. The Commission's collaboration with partners is the focus of the next vision statement.



Biologists use backpack electrofishing devices to stimulate larval sea lampreys out of river bottoms. The data collected help biologists determine which streams to treat with lampricides.

PHOTO: M. GADEN

Biologists continue to monitor the Niagara River and other connecting channels to make sure they have not become significant sources of sea lampreys. PHOTO: C. KRUEGER



In 1998, representatives from state, provincial, tribal, and federal management agencies gathered to sign a revised *Joint Strategic Plan for Management of Great Lakes Fisheries*.

PHOTO: M. GADEN

STATEMENT ON INSTITUTIONAL/STAKEHOLDER PARTNERSHIPS

The Commission will encourage the delivery of complementary programs focused on healthy Great Lakes ecosystems and integrated management of sea lampreys through

- leadership from the Lake Committees in development and pursuit of Fish Community Objectives,
- coordination of fish management programs,
- development of coordinated research programs,
- recognition of Fish Community Objectives by environmental agencies as these agencies implement their programs, and
- strengthened and broadened partnerships among fish management agencies, environmental agencies, and non-agency stakeholders.



Lake committee meetings are critical in the cooperative management of the Great Lakes fishery. Every year,



biologists, lake managers, law enforcement agents, and sport and commercial fishers meet during lake committee meetings to discuss the latest information about the fishery.

PHOTOS: M. GADEN



Milestones

1. Encourage coordinated fish-management programs
 - Fish Community Objectives will be reviewed after State of the Lake Conferences and revised as necessary.
2. Establish and promote research priorities
 - The Commission will lead a review and revision of lake-specific research priorities in conjunction with State of Lake Conferences and communicate priorities to research funding agencies.
 - New research partnerships will be developed to address priority research.
3. Communicate with environmental management agencies
 - Lake committees will communicate to environmental management agencies the biological, physical, and chemical requirements necessary to meet Fish Community Objectives and will seek to have these requirements incorporated into the plans of these agencies, e.g., into LaMPs and RAPs.
4. Strengthen stakeholder and Advisor relationships
 - Travel funds and a policy for their use by citizen Advisors will be established by 2002 to promote communications between Advisors and their constituents and between Advisors and Commissioners.
 - The Commission's communications program will be evaluated and updated by 2003 to strengthen relationships with stakeholders and Advisors.
 - A communications framework for *A Joint Strategic Plan for Management of Great Lakes Fisheries* will be developed and implemented by 2003.
- 5) Increase partnership funding
 - Partnership funding for enhanced delivery of Commission programs will increase and be reported annually.



Rationale for the Partnership Vision Statement

This vision statement is concerned with the relationships and processes required for achievement of the ecosystem and integrated management of sea lamprey vision statements. Most of the milestones associated with the ecosystem vision statement cannot be accomplished without effective partnerships. The sea lamprey milestones are a primary responsibility of the Commission, but their achievement would be meaningless unless accompanied by complementary fishery management programs, a responsibility of provincial, state, and tribal agencies. Finally, partnerships are clearly essential to the Commission because of its commitment to an ecosystem approach.

Encourage coordinated fish management programs

Effective arrangements for partnerships between the Commission and fishery management agencies have been identified in *A Joint Strategic Plan for Management of Great Lakes Fisheries*, implemented in 1981 and revised and reaffirmed in 1997. This arrangement calls for leadership from the Lake Committees in identifying Fish Community Objectives for each lake and in reporting progress during State of the Lake Conferences. Each Lake Committee has adopted Fish Community Objectives and adopted a schedule for State of the Lake Conferences. To ensure that Fish Community Objectives reflect current knowledge, the Commission will encourage their review and revision by each Lake Committee

after its State of the Lake Conference. The Commission will support implementation of Fish Community Objectives by, for example, advocating them to environmental agencies, coordinating fishery management and research programs, and conducting research.

The Commission's ecosystem milestone on habitat classification and inventory provides one example of how coordination among the Commission, the Lake Committees, and environmental agencies can work to support the Joint Strategic Plan. The Commission, in 1999, adopted a policy on habitat that affirms its resolve for conservation of aquatic habitats and that seeks its achievement through the Joint Strategic Plan with fishery management partners. The Commission, because of its new habitat milestone, has begun research on classification and inventory. Upon development of a workable method of classification, the Commission will advocate the implementation of lake-wide systems of inventory by environmental management agencies. Lake Committees in their State of the Lake Reports would then identify those habitats found to be critical for achievement of Fish Community Objectives and most in need of protection and/or restoration by environmental agencies. This arrangement supports the efforts of Lake Committees to identify environmental objectives, an important strategy in the Joint Strategic Plan.



The Lake Superior Committee, 2001. PHOTO: M. GADEN

Establish and promote research priorities

The Commission is charged in the *Convention on Great Lakes Fisheries* to formulate research needs and to undertake such research as necessary. Early in the previous decade, the Commission, in response to its Strategic Vision, developed fishery research priorities for the entire Great Lakes. In the coming decade, the Commission seeks to identify research priorities for individual lakes and to communicate and encourage their adoption by research organizations and granting agencies and by researchers and managers. This milestone is more ambitious than what was accomplished in the 1990s. Although research priorities were developed and distributed, they did not stimulate an active discussion within the Great Lakes research community. In addition, over the course of



The Hammond Bay Biological Station of the U.S. Geological Survey conducts critical sea lamprey research. PHOTO: USGS

the past decade, some of the research priorities have become outdated. Research priorities will be developed from a variety of sources such as Lake Committees, fishery and environmental organizations, funding partners, and individual researchers. To ensure that research priorities promoted by the Commission remain both current and relevant to fishery needs, priorities for each lake will be evaluated in conjunction with State of the Lake Conferences and the ensuing published report. These reports are used by Lake Committees to document progress on the achievement of Fish Community Objectives. A new report for each lake is produced every 5 years on a rotational schedule among the lakes. Therefore, priorities for each lake will be updated twice in the next decade. At the end of the decade, an evaluation will be undertaken of how these research priorities influenced Great Lakes research.

Consistent with its mandate, the Commission undertakes priority research typically not addressed by other entities. However, a shortage of funds inevitably exists to support all of the high-priority projects needed to achieve its Strategic Vision. Sharing of personnel, facilities, and financial resources with others is an effective approach to address this shortage. During the previous decade, the Commission established a research partnership with Michigan State University and the Biological Resources Division (BRD) of the U.S. Geological Survey.



The Great Lakes Fishery Commission is a part of the Partnership in Ecosystem Research and Management Program (PERM) to better coordinate its research. Dr. Weiming Li (left) and Dr. Mike Jones of Michigan State University are PERM scientists working with the Commission. PHOTO: MICHIGAN STATE UNIVERSITY

This arrangement has been successful in expanding the breadth of the sea lamprey research program in part by attracting additional financial resources and also by increasing interactions and sharing among a wide variety of researchers within these three organizations. A partnership similar to that with Michigan State University and BRD will be developed at a Canadian university. Additional partnerships to address key research will be sought in the coming decade.

Communicate with environmental management agencies

Partnerships between fishery management agencies and the Commission are well established in the Joint Strategic Plan, but the plan cannot be successful without broader partnerships that also include environmental management agencies and non-agency stakeholders. Lakewide Management Plans (LaMPs) and Remedial Action Plans (RAPs) are examples of important environmental plans for the Great Lakes that are coordinated by the International Joint Commission. Lake Committees are charged in the Joint Strategic Plan to identify environmental impediments that inhibit achievement of Fish Community Objectives. The Commission will work with all agencies to communicate the environmental needs of Great Lakes fishes, as defined in Fish Community Objectives and State of the Lake Reports, and to incorporate these needs into environmental plans and programs.

Strengthen stakeholder and advisor relationships

During the last decade, the Commission was successful in establishing Canadian Advisors and in improving opportunities for participation by U.S. Advisors. Canadian Advisors are appointed through consultations between the Ontario Ministry of Natural Resources and the Canadian Department of Fisheries and Oceans. U.S. Advisors are nominated by state governors and appointed by the U.S. Section of the Commission. Advisors represent a broad cross section of interests, and their knowledge, efforts, and perspectives have been important to the delivery of Commission programs. They help communicate the nature and role of Commission programs to Great Lakes stakeholders. To be aware of emerging concerns and issues, Advisors must maintain close contacts with their

constituencies. Advisors, many of whom are unsupported volunteers, must have ready access to Commissioners to share these concerns and issues. The Commission recognizes the importance of advisor communication and will seek to establish adequate travel support so that they can carry out their roles.

Sound relationships that are characterized by open communication between the Commission and stakeholders are needed, both to assess public interests and values and to encourage the stewardship of the Great Lakes. Effective two-way communications are essential for productive relationships with stakeholders, such as recreational and commercial fishing organizations, coalitions of non-users, and agency partners. The Commission will help to develop and implement by 2003 a communications framework among all partners to support implementation of the Joint Strategic Plan. This framework will be evaluated early in the next decade to assess results and, if warranted, redirect efforts. To further pursue partnerships with agencies and non-agency stakeholders, the Commission by 2003 also will evaluate the effectiveness of its overall communications program and will make improvements, including incorporation of emerging technologies.

Increase partnership funding

Partners can often accomplish together what is beyond the scope of individual parties. The strength that comes from partnerships is especially evident



Canadian Advisors meeting in 1999.

PHOTO: M. GADEN

when partners pool resources to engage common objectives associated with large problems. A contribution in 1998 of \$3 million from the state of Michigan to help with the costs of controlling sea lampreys in the St. Marys River is a notable example. These resources, in combination with substantial investments by the Commission in studying flow patterns, in developing special formulations of lampricides, and in planning, resulted in a large-scale treatment of the St. Marys River in 1999. Partnerships will not be sought to defray costs of core programs (e.g., purchase of lampricides) that are recognized as being the responsibility of the governments of Canada and the U.S. The Commission in the next decade will seek more partnerships to enhance existing programs and to begin new programs to meet the challenges posed in achieving its vision statements and milestones.

GLOSSARY

Bayluscide (2', 5-dichloro-4'-nitrosalicylanilide)

A synthetic chemical used to treat bottom areas in deep water and, when used in combination with TFM, to maintain the selectivity of TFM at lower application rates.

biodiversity

The variety of living organisms considered at all levels, from populations through species, and including the variety of habitats and ecosystems that support them.

Convention on Great Lakes Fisheries

An agreement made in 1954 between Canada and the United States to improve and perpetuate the fishery resources of the Great Lakes.

ecosystem

Collectively, all organisms in a community plus the associated physical and chemical environment.

endemic

A highly localized distribution of a species, and here used to denote those species restricted only to the Great Lakes.

extirpated

Exterminated over a distinct part of an organism's native range.

fish community

An assemblage of fish species that interact with each other in a geographically circumscribed unit such as a lake.

Fish Community Objectives

Statements developed by Lake Committees that specify characteristics of fish populations in a Great Lake that are desired to be maintained or changed by the natural-resources agencies responsible for fisheries management. A set of Fish Community Objectives has been or is being established for each Great Lake. These objectives are required by *A Joint Strategic Plan for Management of Great Lakes Fisheries*.

fishery

The act, process, occupation, or season of taking fish.

food web

The organisms in an energy pathway usually depicted as starting with primary producers like algae and higher plants and moving to herbivores and eventually to top predators.

Great Lakes Water Quality Agreement

An agreement between Canada and the United States, originally signed in 1972 and subsequently modified, to improve the water quality of the Great Lakes.

integrated pest management

A type of pest control that seeks to suppress pests to ecologically, economically, and sociologically acceptable levels; to maximize net benefits to society; and to minimize the use of pesticides.

Joint Strategic Plan for Management of Great Lakes Fisheries

A plan originally signed in 1980 and adopted by federal, provincial, state, and tribal natural-resources agencies to guide management of fisheries in the Great Lakes.

LaMP (Lakewide Management Plan)

Plans specified in the Great Lakes Water Quality Agreement that define remedial measures needed to bring a whole Great Lake into compliance with Agreement objectives.

Lake Committee

Committees of natural-resource managers that address issues of common interest about Great Lakes fisheries. Five Lake Committees exist, one for each Great Lake, and each is comprised of one representative from each management authority.

lower lakes

Lakes Erie and Ontario.

native

An individual, group, or population of organisms occurring naturally within an ecosystem.

naturalized

An individual, group, or population of non-native organisms reproducing for many generations.

non-native

An individual, group, or population of organisms introduced by humans into an ecosystem, for example by stocking or by entry through canals.

RAP (Remedial Action Plan)

Plans specified in the Great Lakes Water Quality Agreement that define remedial measures needed to bring an area into compliance with Agreement objectives.

recruitment

Fish that are just entering the adult population or are becoming available to a fishery or to a sampling gear.

rehabilitation

A process of bringing about a recovery to a state similar to, but different from, the original.

Secretariat

The staff of the Commission.

self regulating

Population control by natural means usually based on interactions among individuals, their predators and parasites, and their food supply.

State of the Lake Conferences

Conferences sponsored by Lake Committees every five years for the purpose of reporting achievement of Fish Community Objectives.

State of the Lake Reports

Published reports that describe achievement by Lake Committees of Fish Community Objectives.

TFM (3-trifluoromethyl-4-nitrophenol)

A synthetic chemical used since 1958 to destroy larval lampreys in streams.

top predators

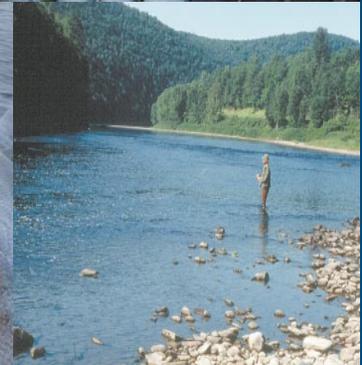
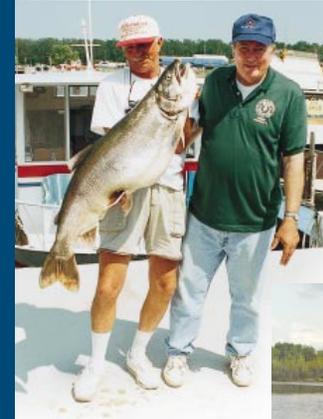
Animals living at the top of food webs; for example, lake trout.

upper lakes

Together, lakes Superior, Michigan, and Huron.

wild

Fish originating from natural reproduction, either by native or non-native species, and not from artificial propagation.



PHOTOS: D. KENYON, MI DNR; GLFC; C. KRUEGER; K. NEIDLINGER; J. SLADE; J. GUNDERSON, MN SEA GRANT;



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