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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
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OCT 2 4 1991

Mrs. Sarah Miller
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Canada

Dear Ms. Miller:

As we discussed, I enclose background material on my Stewardship Indicators Technical Subcommittee, together with a request for help in identifying one or two corporate, Canadian candidates for Subcommittee membership.

Last year the Ecosystems Objectives Working Group of (U.S. and Canadian) Parties to the Great Lakes Water Quality Agreement recommended that formal agreement be reached on five ecosystem objectives for Lake Ontario. These objectives are described in Enclosure 1, 'Ecosystems Objectives of Lake Ontario.' Now, the Subcommittee is asked to identify measurable indicators of progress toward the stewardship objective. As Subcommittee Chair, I have invited a few people to participate actively on the Subcommittee ("Permanent Members," list enclosed). An additional group of "Consulting Members" is also being identified, to gain wider perspectives than can be represented by our small Subcommittee. (Note the enclosed list of Consulting Members.)

It seems to several of us that Subcommittee balance requires at least two, Permanent, corporate members, from Canada and the U.S.

"Responsible stewardship" may initially seem disparate from the other four, conventional ecosystem objectives in Enclosure 1. But people are an integral part of the Great Lakes ecosystem, as is so appropriately stressed by students of the region. So, responsible stewardship is simply another facet of ecosystem structure and function.

For Subcommittee purposes an "indicator" might be a measurable feature of the ecosystem which provides managerially useful evidence of the ecosystem's quality, or of future trend in quality. If we borrow now-conventional ecological approaches, indicators may measure (1) responses to stressors, e.g., intensity or effectiveness of volunteer environmental activity in response to several (probably hard-to-define) stressors; (2) exposure to stressors or degraded habitats; and (3) stressors, per se, such as management actions that change exposure or habitat. We may wish to refine these definitions at our first meeting.

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In order to use the time of members efficiently it seems important to have a straw-person strategy and schedule for the Subcommittee, before our first meeting (probably in December, in Toronto or Buffalo). We are obligated to document the utility of a few stewardship indicators by March 1992. I suggest doing most Subcommittee work at our home offices, using the phone and mail a lot, and having only two or three meetings. Subcommittee members may wish to draft particular indicators, seeking assistance from other relevant perspectives. I understand that adequate support and services will be available for Subcommittee work, including travel expenses for non-agency members, subject to agency regulations.

Many plausible indicators of responsible stewardship are available -- the first task is to focus on the few most useful ones that can be readily implemented. Preliminary telephone conversations suggest that stewardship indicators may well focus on environmental education, economics and values.

We may need some criteria for the most appropriate indicators. Several people have suggested the following criteria:

1. provides information useful to environmental managers/policymakers and the public

2. is sensitive to anthropogenic change in the environment

3. is scientifically defensible

4. is cost effective

5. is measurable, quantitative and, if possible, expressed probabilistically

6. embraces as much as possible of overall "ecosystem health."

Some potential stewardship indicators have already been suggested in broad terms:

1. selected consequences of fluxes from/into the region of:
   a. population
   b. water
   c. food
   .
   .

2. selected consequences of regional land uses and their trends

3. "index of sustainable economic welfare" (= regional product, minus depreciation of capital, plus distributional effects -- after Herman Daly, World Bank)

4. intensity and effectiveness of volunteer stewardship groups, to educate, monitor, restore, etc.

5. implementation by communities of the provisions of LAMPs and RAPs.

I would be very grateful if you could help identify one or two people in Canadian firms who would be interested in joining the Subcommittee to address these issues. In addition to the evident knowledge and "committee skills" desired, I believe it is important that candidates truly represent corporate perceptions. This is because the Subcommittee must both understand corporate perceptions, and consider corporate views in its work.

If you have any questions please call me at 212-264-5356. In order to locate corporate members soon, I would greatly appreciate your calling me about candidates. Thank you very much for your help.

Sincerely,

Joel O'Connor

Joel S. O'Connor
Ocean Policy Coordinator

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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24 MAY 1990

TO: U.S. members of Ecosystem Objectives Work Group

RE: Ecosystem Objectives for Lake Ontario

Enclosed is the final version of the Ecosystem Objectives for Lake Ontario document, following our many discussions and written comments.

This paper has been sent to the Lake Ontario Secretariat, the co-chairs of the Binational Objectives Development Committee, the U.S. Parties Policy Committee, all the participants in the March workshop, and all the correspondents who provided comments and suggestions.

Our next task will be to identify the measurable indicators for each objective. If you haven't already done so, give some thought on how to structure your technical subcommittee(s) to develop one or more indicators for your objective, and what schedule would be reasonable. I will be calling soon to get your first thoughts, then we may try to have a conference call sometime in the next 2 or 3 weeks.

The Parties meet June 14, and EOWG will be in the spotlight for actually achieving something. We will present the Objectives for Lake Ontario as an information item and progress report. However, I expect that we will be pressured to also provide a schedule for the indicators work.

I thank you for your hard work on this project.

Sincerely,

Paul

Paul Bertram
U.S. Co-chair EOWG

Attachment

ECOSYSTEM OBJECTIVES FOR LAKE ONTARIO

Prepared by the Parties to the

GREAT LAKES WATER QUALITY AGREEMENT

Ecosystem Objectives Working Group

March 1990

INTRODUCTION

The first Great Lakes Water Quality Agreement (GLWQA), signed by the Governments of Canada and the United States in 1972, emphasized restoration of water quality based solely on water chemistry. However, when the Agreement was revised in 1978 and 1987 an ecosystem approach to restoration and maintenance of Great Lakes water quality was adopted. The ecosystem approach acknowledges that all components of the ecosystem - humans, plants, animals, land, air and water - are interdependent, and that a detriment to one component will inevitably be a detriment to another. The revised Agreement now requires the development of both ecosystem and chemical-specific objectives.

Ecosystems are basic functional units which include both living organisms and the non-living environment, each influencing the properties of the other and both necessary for the maintenance of life. Ecosystems can be perceived and examined on a scale ranging from a small pond to a continent and, ultimately, the entire globe. Healthy ecosystems are in a state of dynamic equilibrium, subject to fluctuations in their biological, chemical and physical components, but with feedback mechanisms to keep oscillations within well-defined boundaries. A well-known example is the lemming cycles in the Arctic which show extreme, but normal, fluctuations in relation to food supply and predators.

In 1985, a significant step in the development of ecosystem objectives was taken by the International Joint Commission (IJC) in cooperation with the Great Lakes Fishery Commission (GLFC) with the publication of "A Conceptual Approach for the Application of Biological Indicators of Ecosystem Quality in the Great Lakes Basin". This report offered criteria for selecting ecosystem objectives, and it led to the inclusion of the first two indicators in the GLWQA; that is, that stable self-reproducing populations of lake trout and the amphipod Pontoporeia hoyi would indicate a healthy Lake Superior ecosystem. A second effort through the IJC concentrated on the identification of indicator species for the more productive, mesotrophic waters of the Great Lakes (e.g., Western Lake Erie, Green Bay, Saginaw Bay).

This effort has not yet been completed, although the percid community and the mayfly Hexagenia limbata are being considered as appropriate indicators of ecosystem health in mesotrophic waters of the Great Lakes.

The 1987 revisions to the Great Lakes Water Quality Agreement make clear that the development of objectives for the Great Lakes is the responsibility of the Governments of Canada and the United States. To undertake this task, the Governments established the Binational Objectives Development Committee which, in turn, created the Ecosystem Objectives Work Group. The initial focus of the Work Group was on developing ecosystem objectives for Lake Ontario in conjunction with the Lake Ontario Toxics Management Plan.

Determining the scope of the Lake Ontario ecosystem objectives was one of the first challenges facing the Work Group. Even though ecosystems are by definition open systems with obvious differences between adjacent ecosystems, they often interact strongly with one another and are dependent on each other. The development of ecosystem objectives targets the aquatic ecosystem of Lake Ontario and incorporates the surrounding basin as it is necessary for wildlife species utilizing the lake for habitat or food. Furthermore, humans are recognized as an integral part of the lake ecosystem, and we are dependent on ecosystem processes for maintaining our health and viability. Since the 1750s, the enormous growth in human population, major changes in land use, and industrialization have dramatically altered the Great Lakes ecosystem. Although ecosystems are remarkably resilient, they cannot recover from severe stresses without being altered, and because a healthy ecosystem is essential for human society, it is appropriate to develop ecosystem objectives to protect our health and that of the ecosystem in general. Wise management practices can help achieve sustainable development, ensuring that the utilization of the lake's resources and the environment does not diminish prospects for their use by future generations. Human health in the basin is considered as it is affected by the waters of Lake Ontario in the broadest sense; that is, the use of Lake Ontario for drinking water and swimming, as well as the consumption of fish and wildlife, should not pose risks to human health.

The development of ecosystem objectives for Lake Ontario have three components. The first is a statement of goals, which reflect societal values in and around Lake Ontario. The second is a set of ecosystem objectives for various components of the ecosystem that would ensure attainment of the goals. Finally, one or more indicators will be selected for measuring progress toward each objective. The indicators must be measurable and quantitative. Three goals and five objectives have been selected for Lake Ontario. Indicators for attainment of these objectives are not presented at this time, but will be identified in the near future by the Ecosystem Objectives Work Group in consultation with the public and with technical experts in each subject area.

Human society derives many benefits from Lake Ontario, all of which ultimately depend on a properly functioning ecosystem. Ten per cent of the Canadian population and one per cent of the American population use Lake Ontario for drinking water. The Great Lakes fishery has an estimated annual worth of $0.5 - 2 billion, to which Lake Ontario is a major contributor. Major cities were founded in the Lake Ontario watershed because of the benefits associated with the Lake Ontario ecosystem. An intact and properly functioning Lake Ontario ecosystem is a resource beyond value. Therefore, we must ensure that our society does not continue to threaten the value of this resource.

Since the 1750s, expansion of human settlement and related activity has resulted in increasing disruption of the Lake Ontario ecosystem. Some of the more significant stresses on the ecosystem have been:

> Deforestation. Deforestation was contemporary with the initial settlement of the basin. By the 1830s commercial logging was underway and in less than 150 years almost the entire Lake Ontario watershed had been denuded. The removal of tree cover had profound effects on the ecosystem. Many large terrestrial mammals such as elk, caribou and bear no longer had suitable habitat. The loss of tree cover increased the rate of runoff, causing more flood erosion and warmer temperatures in

surface waters. Late summer stream flows were reduced and many headwater streams dried up. This effect, which was greatly compounded by the construction of dams blocking access to tributaries, severely reduced the spawning grounds available to several important fishes such as Atlantic salmon.

Loss of Wetlands. Coastal wetlands are often the most biologically productive areas in a water body and they provide breeding habitat for many important species. They also serve a cleansing function. Unfortunately, people often assign little or no value to keeping wetlands intact and many have been drained and infilled for residential, agricultural or industrial use. Since the 1750s, more than half of the original wetlands in the Lake Ontario basin have been lost. For example, the shoreline of Hamilton Harbour has been reduced from 65 to 34 kilometres, resulting in a loss of extensive marsh land to industrial use. This practice continues today, severely restricting the productive warm water commercial fishery and the haven for thousands of migrant and resident birds and other wildlife.

Excess Nutrients. Excessive inputs of nutrients, especially phosphorous and nitrogen, from municipal, industrial and agricultural sources have caused major deterioration of water quality in some parts of the Great Lakes, and led to the development of the first Great Lakes Water Quality Agreement. For example, inputs to the Bay of Quinte have caused changes such as excessive growth of phytoplankton and larger algae at the expense of wild rice and submerged aquatic plants and, consequently, changes in the fish and invertebrate communities. Although major strides have been made in controlling nutrient loadings to the Great Lakes, many Areas of Concern are still affected by excess nutrients.

Contaminants. Toxic chemical stress is expressed in deformities and reproductive failures in fish-eating birds and mammals, in tumors and deformities in fish, and in degraded bottom-dwelling communities. Bioaccumulation of chemicals in large, long-lived predatory fish is sufficient to warrant concern and has led to fish consumption advisories. Ecosystem objectives must, therefore, address problems related to contaminants as they affect fish and wildlife, as well as human health and the use of Lake Ontario resources.

Exotic Species. Many exotic species, including the sea lamprey, alewife and, most recently, the zebra mussel, have successfully invaded the Great Lakes. Most exotic species have incidentally entered the lakes through shipping canals and other human interventions, whereas a few, such as Pacific salmon and carp, were purposefully introduced. Although some exotic species seem to be accommodated with minimal ecosystem disruption, the results of the invasion of most exotic species has been costly, both to human uses of the Great Lakes and to the populations of native species.

Over-utilization. Selective over-harvesting of desirable, high-value species has caused the extinction of some native species and has changed the fish and wildlife community, perhaps irreversibly in some areas. To attain our ecosystem objectives for Lake Ontario, we must manage and regulate game species to ensure the maintenance of stable reproducing populations that can provide a harvestable surplus.

While Lake Ontario cannot become the ecosystem it was in 1750, a desirable target lies between its former state and its present condition. It is likely that the ecosystem of 200 years ago represents the last example of a

healthy, fully functional ecosystem which was self-sustaining and capable of adjusting to extremes of environmental fluctuations and change. In contrast, today's ecosystem is less stable and is sustained by human intervention, such as fish stocking and water level control. Recovery steps can be taken so that Lake Ontario supports many of its original, highly valued native species. Therefore, a reasonable ecosystem target would include a community that, to the greatest practicable degree, represents that which formerly existed.

GOALS

The three goals which set the framework for the ecosystem objectives for Lake Ontario are:

1. The Lake Ontario ecosystem should be maintained and as necessary restored or enhanced to support self-reproducing diverse biological communities.

2. The presence of contaminants shall not limit the use of fish, wildlife and waters of the Lake Ontario basin by humans and shall not cause adverse health effects in plants and animals.

3. We as a society shall recognize our capacity to cause great changes in the ecosystem and we shall conduct our activities with responsible stewardship for the Lake Ontario basin.

ECOSYSTEM OBJECTIVES

1. Aquatic Communities

The waters of Lake Ontario shall support diverse healthy, reproducing and self-sustaining communities in dynamic equilibrium, with an emphasis on native species.

Rationale

Historically, the offshore open waters of Lake Ontario were cool, clear and low in nutrients. Large increases of nutrients, such as phosphorus, caused changes in water quality and subsequently in the types of plants and animals living in Lake Ontario. These changes are widely considered ecologically and socially unacceptable, and there is continued public support for phosphorus control and for other associated remediation efforts. Large predatory fish, such as lake trout, integrate food web and habitat components of the ecosystem, and bottom-dwelling organisms (benthic invertebrates) link the sediments and the water. Therefore, healthy and reproducing communities which include large predatory fish and benthic invertebrates are desired for the open, offshore waters of Lake Ontario.

Some nearshore areas and embayments of Lake Ontario historically tended towards a state of moderate nutrients and high levels of biological productivity. This productivity is presently limited by degraded and contaminated water, sediment, and prey species. The destruction and harmful alteration of physical habitat, interaction with undesirable introduced species, and over-fishing also contribute to the problem. Healthy and reproducing communities of predatory fish and bottom-dwelling organisms are desired in all nearshore areas of Lake Ontario. Those nearshore areas that historically had lower nutrient characteristics, however, should be maintained in a low nutrient state to support their representative community of plants and animals.

Sustainable ecosystems contain populations of plants and animals that fluctuate within certain limits. In Lake Ontario, predatory fish control the population size of many species and the structure of the biological communities. Therefore, these communities should be sustained by natural reproduction complemented by the judicious use of hatchery-reared native and non-native species to maintain predator-prey balance and a diversity of benefits in nearshore and offshore regions.

2. Wildlife

The perpetuation of a healthy, diverse and self-sustaining wildlife community that utilizes the lake for habitat and/or food shall be ensured by attaining and sustaining the waters, coastal wetlands and upland habitats of the Lake Ontario basin in sufficient quality and quantity.

Rationale

Wildlife that feed on fish and other aquatic organisms are an integral part of the Great Lakes basin ecosystem. They include birds, mammals, amphibians and reptiles, and they occupy many ecological niches. Some are year-round residents in the Great Lakes basin, while others are seasonal residents or migrants.

Since the 1750s, the wildlife community of the Great Lakes basin has changed dramatically. Most of these changes have been influenced by habitat destruction, over-harvesting, contaminants, the introduction of exotic species and other stresses. Habitat destruction and alteration limit the distribution and abundance of wildlife, contributing to a decline in the viability of wildlife populations in those areas where wildlife still occur. Contamination from toxic chemicals may cause death of adults, but most documented cases of contaminant effects involve reproductive impairment and the increased occurrence of deformities in bald eagles, double-crested cormorants, herring gulls, mink and snapping turtles. Over-harvesting can seriously deplete numbers and lead to the local extinction of some species; e.g., passenger pigeon and wild turkey. Introduced species may compete directly or indirectly with, and usually to the detriment of, native species. Also, some migratory and winter-resident waterfowl (e.g., oldsquaw and scaup ducks) accumulate contaminants from the Lake Ontario basin that may cause health or reproductive failure when the birds migrate to other areas of their range.

3. Human Health

The waters, plants and animals of Lake Ontario shall be free from contaminants and organisms resulting from human activities at levels that affect human health or aesthetic factors such as tainting, odour and turbidity.

Rationale

The protection of human health is necessary in the Lake Ontario ecosystem. While humans have caused much of the degradation of the lake, we, as elements of the ecosystem, are also exposed to the contaminants we have created. In some areas, discharges of contaminants (chemical, physical and biological) have adversely affected drinking water, fishing and swimming and have resulted in advisories on fish consumption and in closures of swimming beaches.

Consumption of certain Lake Ontario fish and wildlife can result in significant intake of chemical contaminants. Depending on the level of exposure, some of these contaminants have caused a range of adverse health effects, as demonstrated in laboratory animals and as observed in wildlife and humans. Human health issues include a range of pathologic physiological effects such as; developmental defects, impairment of the immune system, reproductive impairment, and cancer. There are also social and psychological implications of contamination such as loss of the native subsistence fishery, loss of recreational opportunities or fear of living in a community where contaminants may affect health. In addition, serious contamination of Lake Ontario by disease-causing micro-organisms continues to occur when combined storm and sanitary sewers overflow and discharge to the lake.

4. Habitat

Lake Ontario offshore and nearshore zones and surrounding tributary, wetland and upland habitats shall be of sufficient quality and quantity

to support ecosystem objectives for health, productivity and distribution of plants and animals in and adjacent to Lake Ontario.

Rationale

Habitat is so critical to the maintenance of a healthy, diverse and self-sustaining ecosystem that a separate objective is considered necessary. Ecosystem objectives for fish and for wildlife using Lake Ontario will be met only if sufficient habitat of suitable quality is available when and where needed. This requires that substantial habitat be returned to productive capacity, which means that the quantity and condition of habitat required to produce and support healthy fish and wildlife will be available, as well as the habitat which produces and supports the organisms upon which fish and wildlife depend.

In many areas, access by fish and wildlife to critical breeding and feeding habitat has been precluded by human development. For example, habitat has been greatly modified by activities such as dredging, channelizing, draining, filling, contaminating, and constructing dams and dikes. Sedimentation also damages habitat. In addition, the stabilization of lake levels would further threaten important coastal wetlands and the breeding habitat of many fish and wildlife species.

Attainment of the other ecosystem objectives should improve habitat for fish and wildlife. However, the first step towards achieving the habitat objective will be to identify wildlife and fish habitat requirements, such as vegetation, substrate or water depth. An inventory of habitat availability will also be required.

5. Stewardship

Human activities and decisions shall embrace environmental ethics and a commitment to responsible stewardship.

Rationale

The ability of human society to profoundly affect the ecosystem, together with our dependence on it, requires that we adopt an environmental ethic to guide our society's activities. Our tendancy to consider ourselves separate from the ecosystem has greatly contributed to the degradation of Lake Ontario. Because the lake has long been taken for granted and exploited rather than valued, we must now do more than recognize our influence in the ecosystem. We must accept responsibility for maintaining the ecological processes and components of Lake Ontario, preserving its biological diversity and following the principles of sustainable use of resources. Increased acceptance of this responsibility by all sectors of society is required to ensure that future generations inherit a better environment. Responsible stewardship includes: educating society about current resource uses and practices which jeopardize ecosystem integrity; advocating environmentally-sound behaviour in individuals and communities; and making changes to activities which contribute to the degradation of the ecosystem. Many issues, such as achieving zero discharge of persistent contaminants, and the introduction of exotic species, will be more easily resolved with such an approach.

GLOSSARY OF TERMS

Area of Concern: a geographical area that fails to meet the general or specific objectives of the Great Lakes Water Quality Agreement where such failure has caused, or is likely to cause, impairment of beneficial use or of the area's ability to support aquatic life.

bioaccumulation: uptake and retention of environmental substances by an organism from both its environment (e.g., directly from the water) and its food.

contaminant: substances which can cause or contribute to death, disease, behavioural abnormalities, cancer, genetic mutations, physiological or reproductive malfunctions, or physical deformities in any organism or its offspring, or which can become poisonous after concentration in the food chain or in combination with other substances, or which causes or contributes to changes in ecosystem function.

contaminants - biological: organisms such as bacteria, viruses, and protozoa that are released into the environment from untreated effluent from sewage treatment plants, industrial effluent, landfill sites and agricultural lands.

contaminants - chemical: both organic (e.g., PCBs, dioxin) and inorganic (i.e., heavy metals) chemicals that enter the environment as the result of human activity.

contaminants - physical: substances such as sediment, sludge, and pulp mill debris entering the environment as the result of human activity.

dynamic equilibrium: the result of fluctuations of the biological, chemical and physical components of the ecosystem within well-defined boundaries.

cotic species: species not native to the Great Lakes that have een intentionally or inadvertently introduced into the system.

ealthy: a state of vigour and general well-being, unhampered by nvironmental contamination, capable of natural reproductive rates, free of disease caused by exposure to contaminants.

mesotrophic: waters with a moderate supply of nutrients and hence a moderate organic production; e.g., in the centre of a continuum between oligotrophic (poor in nutrients) and eutrophic (rich in nutrients).

native species: self-reproducing species indigenous to a particular ecosystem, region or area, e.g., those species that occurred in Ontario before the North American colonization beginning in the 1750s.

pathologic physiological effects: effects of disordered function of living organisms and their parts or functions of diseased tissue.

percid community: a community of fish belonging to the perch family (e.g., yellow perch, walleye).

productive warm water fishery: a co-evolved, integrated assemblage of fish in north-temperate eutrophic areas characterized by the presence of centrarchids (sunfish family), cyprinids (minnow or carp family), and ictalurids (catfish family).

stable self-reproducing populations: populations which are sustained by natural reproduction, rather than by stocking from hatcheries, and which remain constant in numbers within normal fluctuations.

sustainable development: human use of the ecosystem that meets the needs of the present without compromising the ability of future generations to meet their own needs.

upland habitat: land elevated above the lowlands associated with rivers, marshes and lakes.

EOWG Subcommittee on Stewardship for L. Ontario

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