GREAT LAKES FISHERY COMMISSION

1994 Project Completion Report[1]

Sustainability of the Intensively Managed Fisheries of Lake Michigan and Lake Ontario

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SUSTAINABILITY OF THE INTENSIVELY MANAGED FISHERIES OF LAKE MICHIGAN AND LAKE ONTARIO

FINAL REPORT OF THE SIMPLE TASK GROUP

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INTRODUCTION

Sustainability of Intensively Managed Populations in Lake Ecosystems (SIMPLE) is a Task Group of the Board of Technical Experts of the Great Lakes Fishery Commission. By focusing on the intensively managed fisheries of Lakes Michigan and Ontario, the Task Group addressed issues arising from an ecosystem approach to fisheries management. The guiding purpose of the Task Group was to develop a framework for evaluating the risks of artificially maintained fisheries and, thereby, help managers move Great Lakes fisheries, where possible, to more sustainable configurations. The specific objectives were (1) to synthesize scientific understanding regarding ecological processes governing stability in Great Lakes fish communities; (2) to assess the influence of a range of management options on stability; (3) to evaluate the extent to which the social preferences and institutional concerns constrain options for Great Lakes fisheries management; (4) to promote communication across disciplinary lines usually separating water quality management from fisheries management; (5) to share the study's findings with those involved in making decisions about Great Lakes fisheries management; and (6) to develop recommendations for future management direction, priorities for research and monitoring, and a plan for continuing evaluation of management goals and options.

The SIMPLE Task Group grew of out a request by fish managers to the Board of Technical Experts to initiate a research program that would address the issue of long-term stability of fish communities and fisheries of the Great Lakes. This management concern was a response to the "roller-coaster ride" history of Great Lakes fisheries. Over the past 50 years, fish communities in the Great Lakes have shown great variation in structure and harvest. By 1950, a history of overexploitation, invasion of sea lamprey, smelt, and alewife, and eutrophication had combined to decimate native top predators and displace endemic planktivores. By 1960, lake trout were extirpated from Lake Michigan, Eastern Lake Erie, and Lake Ontario. Lake trout in Lake Huron were reduced to a few remnant stocks, and the diversity of lake trout stocks in Lake Superior had been greatly reduced. These losses coupled with the extirpation of blue pike from Lake Erie and Western Lake Ontario resulted in fish communities with a severe deficit of predators. Not surprisingly, populations of formerly subdominant species or new invading species exploded in their absence. Alewife in Lake Michigan, for example, became so abundant that spring mortality became an increasingly severe nuisance problem, culminating in a massive die-off in 1967.

Responding to the collapsing fisheries, management agencies and the federal governments initiated a series of rehabilitation measures. The federal governments formed the Great Lakes Fishery Commission, and it began to control sea lamprey in the Great Lakes by the late 1950's. In the mid-1960's, success of sea lamprey control allowed the start of a large stocking program to restore lake trout populations. Supplementing this program to reestablish native predators, large scale planting of other trout and exotic salmonids (rainbow trout, *Oncorhynchus mykiss*; Chinook salmon, *Oncorhynchus*

tshawytscha; coho salmon, *Oncorhynchus kisutch*; and brown trout, *Salmo trutta*) began in Lake Michigan and spread to other lakes during the following decade. In 1980, all of the agencies with management authority on the Great Lakes committed themselves to a policy of obtaining "...fish communities, based on foundations of stable self-sustaining stocks..." as a long term goal (Great Lakes Fishery Commission 1980).

The 1980's witnessed a remarkable recovery of fisheries. By 1984, Dochoda (Great Lakes Fishery Commission, personal communication) estimated that more than 430 million salmon and trout had been stocked. Due to this stocking program, high valued recreational fisheries developed for salmon and trout in Lakes Michigan, Huron, and Ontario. Lake Superior experienced a resurgence of its lake trout stocks, and elimination of overfishing led to a dramatic recovery of walleye in Western Lake Erie. Public reaction to these increased fishing opportunities, however, has created an ever growing demand that threatens to undermine long term goals of fishery management. Re-establishment of self-sustaining stocks of native lake trout throughout the Great Lakes requires trade-offs in levels of exploitation and stocking that are beginning to conflict with emerging angler preference. Simply stated, the angling public, especially for Lakes Michigan and Ontario, is demanding levels of harvest of Chinook and Coho salmon that can only be maintained through extensive artificial propagation.

These trends of collapse, recovery, and spiraling increases of new demand are typical of unstable fisheries systems. The original goal of establishing self-sustaining stocks sought to improve the stability of Great Lakes fisheries, but success has wrought unexpected risks. Eshenroder (1989)[1] identified several stability related concerns: competition for forage between lake trout and stocked salmonids, vulnerability of stocked salmonids to hatchery diseases or loss of genetic fitness, future invasions of exotic, and angler intolerance for depressions in stocked trout and salmon. The latter risk, according to Eshenroder (1989), in fact, reduces the scope of possible management actions. The future of fisheries management in the Great Lakes involves balancing self-maintaining and artificially maintained components. The central problem confronting the task group, therefore, was the question: "Is the long-term stability of Great Lakes fisheries limited by our current management practices, and, if so, how great are the risks and what are the alternatives?"

To guide implementation of the evaluation framework, the Task Group began a series of workshops and technical working meetings to develop computer models with which to explore the consequences of fishery management options (Figure 1). The work of the Task Group was guided by a core team consisting of Michael Jones and Joseph Koonce, who served as co-chairs, and Richard Hess (Illinois Department of Conservation), John Williamson (Ontario Ministry of Natural Resources), and Randy Eshenroder (Great Lakes Fishery Commission), who represented the interests of fish managers. The first workshop in January, 1991, produced detailed conceptual models of Lake Michigan and Lake

[1] Eshenroder, R. L. 1989. A perspective on artificial fishery systems for the Great Lakes. Paper presented at Wild Trout IV, Yellowstone National Park, September 18-19, 1989. 8 pp.

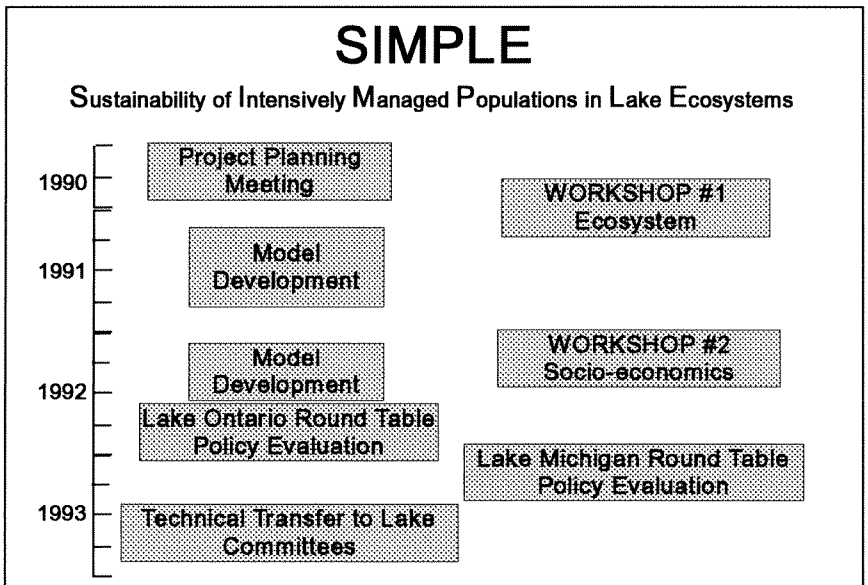

Figure 1. Summary of major activities of the SIMPLE Task Group.

Ontario that captured the ecological context of management options. During the following summer and fall, these conceptual models evolved into two simulation models of the fish communities of each lake through a series of technical working meetings. The second workshop (April 1992) focused on incorporation of social and economic factors into the simulation models and on the preparation for the realistic evaluation of management policies in their full ecological, social, economic, and political context. After more model development, the Task Group hosted two round tables for policy evaluation, one for Lake Ontario in October 1992 and the other in January 1993 for Lake Michigan. Reports of these two round tables are included in appendices II and III. Finally, the Task Group concluded its work with a Technology Transfer Workshop (December 1993) and distribution of models for Lake Michigan and Lake Ontario to representatives of the technical committees for each lake (January 1994).

PROJECT ACCOMPLISHMENTS AND FINDINGS

The SIMPLE Task Group achieved most of its objectives. The project succeeded in establishing a framework for the evaluation of the sustainability of fish management options for Lakes Michigan and Ontario and assisted managers in their deliberations over future stocking options. Table 1 lists the primary products of the Task Group. Progress on the specific objectives was also significant (Table 2). The approach adopted by the SIMPLE Task Group was the Adaptive Environmental Assessment and Management (AEAM) methodology[2] As expected, the most important product of this approach was the process itself. Participants in the workshops came from Provincial, State, and Tribal management authorities, Department of Fisheries and Oceans, U.S. Fish and Wildlife Service, academic institutions,

[2] Holling, C. S. [ed.] 1978. *Adaptive Environmental Assessment and Management*. John Wiley and Sons, New York. 377 pp.

Table 1. Products of SIMPLE Task Group

Reports

SIMPLE Task Group Final Report (May 18, 1991). Report of SIMPLE Workshop I to develop a conceptual model of the Lake Michigan and Lake Ontario fish communities. 14 pp.

Proceedings of SIMPLE Workshop II. A report of the socio-economic impacts workshop of the SIMPLE Task Group. June 1992. 13 pp.

Proceedings of the SIMPLE Lake Ontario Round Table. A report of the Lake Ontario Round Table of the SIMPLE Task Group, Alliston, Ontario October 21-23, 1992. 16 pp.

Proceedings of the SIMPLE Lake Michigan Round Table. A report of the Lake Michigan Round Table of the SIMPLE Task Group, Wingspread, Racine, Wisconsin, January 19-21, 1993. pp.

Publications

Jones, M. L., J. F. Koonce, and R. O'Gorman. in press. Sustainability of hatchery-dependent fisheries in Lake Ontario: the conflict between predator demand and prey supply. Trans. Amer. Fish. Soc. (accepted for publication).

Newsletters:

SIMPLE Newsletter Vol 1, No. 1

SIMPLE Newsletter Vol 2, No. 1

Software

Lake Ontario Model

Lake Michigan Model

organizations representing various fishery interests, and organizations representing broader interests in the future of the Great Lakes. Appendix I lists individuals participating in the initial workshops and round tables. Assembling this range of participants was vital to the development of credible models and open communication of alternate points-of-view, preferences for future management options, and possible consequences of these choices.

The Round Table format proved to be very successful. Non-governmental participants, in particular, found the format to be a productive way of communicating the context of management decisions and of understanding the constraints that fish managers must work around. Public participation is this format is not adversarial. Managers are not proposing regulations or management options for comment. Rather, the Round Table format seeks to provide a common meeting ground for the communication of concerns and ranges of solutions. Disagreements occur, but the primary emphasis is on finding areas of agreement and common understanding of the problems in developing a sustainable fishery. This emphasis appears to be a better way to build public consensus for management decisions. Open discussions before decisions are made provide more opportunities to explore and understand the consequences of the ultimate decisions. Models of the fish communities play an important role in this process. Because they are a product of a consensus building exercise, the models are objective statements of the current understanding of the regulation of fish community structure. Due to knowledge limitations, the models were probably wrong in some details. Nevertheless, the use of the models imposes a check on the internal consistency of arguments for various management options or beliefs about the state of the fish

Table 2. Summary of activity related to each of the specific objectives of the SIMPLE Task Group.

Specific Objective	Accomplishments
(1) to synthesize scientific understanding regarding ecological processes governing stability in Great Lakes fish communities	Consensus at Workshop 1 was obtained and incorporated into the fish community models of Lake Michigan and Lake Ontario.
(2) to assess the influence of a range of management options on stability	The key stability issue was the persistence of alewife prey under various species-combinations and levels of salmonid stocking. Models were used to explore various stocking scenarios.
(3) to evaluate the extent to which the social preferences and institutional concerns constrain options for Great Lakes fisheries management	This was the topic of Workshop II. Constraints were explored, but proved difficult to incorporate directly into models. Concerns directly addressed in policy gaming exercises at Round Tables.
(4) to promote communication across disciplinary lines usually separating water quality management from fisheries management	Explicit representation of varied interest groups throughout the project and publication of a Newsletter helped promote communication of central issues.
(5) to share the study's findings with those involved in making decisions about Great Lakes fisheries management	Results of the project were consistently reported to Lake Committees and to the GLFC at their annual meetings. Task Group core team members also participated in technical committee meetings for both the Lake Michigan Committee and Lake Ontario Committee.
(6) to develop recommendations for future management direction, priorities for research and monitoring, and a plan for continuing evaluation of management goals and options	The Task Group added a final technology transfer workshop and identified mechanisms to assist the continuing use of the process and models. Final report summarizes recommendations.

community. Uncertainty is not ignored in this process. Its exploration becomes a central feature of understanding the consequences of the options preferred by various interest groups.

Apart from their contribution to the Round Table process, the models the Lake Michigan and Lake Ontario fish communities also contributed to the evolving scientific understanding of the ecology of both lakes. The Lake Michigan Technical Committee used the modeling framework as organizational focus for information gathering and hypothesis testing associated with questions about the fate of Chinook salmon in Lake Michigan. The model has also been used to help explore expectations of fish yields and changes in fish community structure for various interpretations of Lake Michigan Fish Community Goals. The model received similar attention in the ongoing debate about the potential predator-prey imbalance in Lake Ontario, and contributed to preparations for the public consultation process initiated by New York and Ontario in regard to possible stocking reductions in the face of a potential collapse of the alewife abundance in Lake Ontario. These applications of the models proved useful enough that management agencies requested further technology transfer efforts to establish a core group of technical experts who could continue to maintain the models and update them as better understanding emerges from current research and monitoring.

A consensus emerged from the work of the Task Group that the recent initiatives of fish management agencies may not be sustainable. Clearly, the prey populations of Lake Michigan and Lake Ontario are vulnerable to sharp declines if stocking continues at recent levels. Figures 2 and 3 illustrate some of the model predictions for both lakes. The validity of these predictions depends upon some key assumptions and the influence of climatic factors, which are unpredictable. It appears, however, that rather large reductions in stocking will be needed to reverse alewife decline, if it is, in fact, reversible at all. Additional research will be required to obtain better understanding of the risks associated with various management options, but these findings add support to the urgency of the efforts of fish managers to develop more explicit, long-term objectives for the fish communities of Lake Michigan and Lake Ontario. Because models play such an important role in evaluating and communicating the consequences

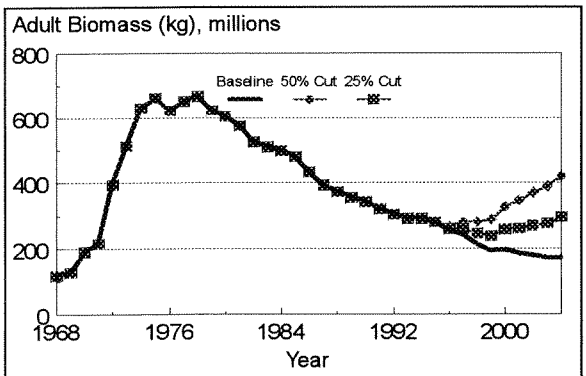

Figure 2. Predictions of effects of various stocking cuts on alewife abundance in Lake Michigan.

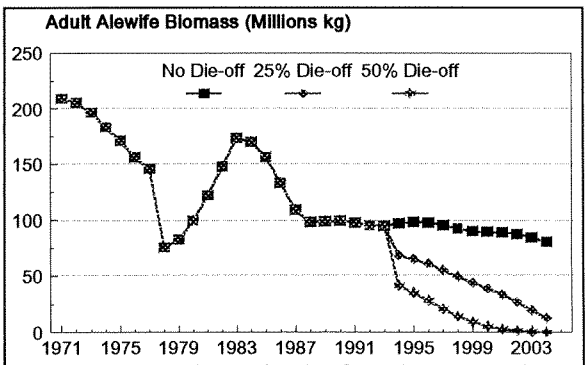

Figure 3. Predictions of Lake Ontario Model of trends in alewife biomass at current salmonid stocking levels given severity of over-winter mortality.

of fish management policy options, it would appear that something like the SIMPLE models should be incorporated into the evolving fish community objectives for each of the Great Lakes.

CONCLUSIONS AND RECOMMENDATIONS

In attempting to develop a framework for evaluating the risks associated with artificially maintained fisheries, the SIMPLE Task Group has uncovered substantial opportunities and challenges to implementing sustainable, fish management in the Great Lakes. Dealing with public expectations has clearly become as complex as understanding ecological relationships. One of the conclusions of the workshop on social and economic factors was that vague or generally stated long-term goals for fish communities do not provide sufficient guidance for managers nor do they make explicit the social and economic trade-offs that are required to achieve a biologically stable structure of fish communities. Public understanding and acceptance of these trade-offs is essential to establishing a new basis for public expectation and preferences based on stewardship principles. Participants in the Round Tables found this format productive at building common understanding of the problems confronting management of the fish

communities of the Great Lakes. The Task Group, therefore, recommends that the GLFC and BOTE consider ways of incorporating this Round Table format into other policy venues in which public preference and science play joint roles in policy formation and screening of management options.

Another challenge is to improve the scientific basis for sustainable fish management. The Task Group only began a superficial consideration of sustainability issues. Much of the model analysis addressed a narrower issue of balance of predator and prey populations in Lake Michigan and Lake Ontario. Underlying this question, however, are needs for more fundamental research in three general areas: the influence of biodiversity on sustainable fisheries management, determinants of productive capacity of large lake ecosystems, and strategic approaches to establishing and pursuing sustainable production goals. The BOTE research priorities[3] addressed these points, but the Task Group recommends their reconsideration along the following lines:

- Recommendation on biodiversity research. In a restoration context, the influence of biodiversity on sustainable production becomes important with decisions on long-term goals for the structure of fish communities. This is a central problem confronting the drafters of Fish Community Objectives for each of the Great Lakes. An important scientific issue concerns the significance of species composition. Are there any adverse ecological consequences (e.g. ecosystem instability or diminished production) associated with preserving alewife dominance over indigenous planktivores? The tropho-dynamic approach taken in the SIMPLE models is insufficient to explore the effects of species composition on ecosystem structure. What is required is a more explicit analysis of the interaction of biodiversity (both species composition and stock structure) with ecosystem energetics through a combination of modeling studies, historical analysis, and emerging techniques for complementing diet studies with stable isotope ratios.
- Recommendation on productive capacity research. The SIMPLE have addressed the stability of predator-prey balance for various levels and combinations of salmonid stocking. With future improvements in tributary and near-shore habitat, natural reproduction will become a more important consideration in the decisions on stocking programs in Lake Michigan and Lake Ontario. However, there remain substantial gaps in knowledge of the relative contribution of habitat, biodiversity, and nutrient loading in determining the productive capacity of these ecosystems for top predators. A fundamental principle of sustainable fishery management is that maintenance of fish community structure should not require major stocking programs, i.e. there should be a major emphasis on self-sustaining populations. The

[3] Great Lakes Fishery Commission. 1993. Research Priorities for the 1990s. William Taylor [ed.]. Board of Technical Experts. Great Lakes Fish. Comm., Ann Arbor. 14 pp.

interaction of habitat and biodiversity seems to be emerging as an important linkage, which currently limits lake trout reproduction[4]. This research must go beyond a classification and inventory of habitat to a more fundamental exploration of the evolutionary ecology of the adaptation of fish populations to habitat constraints in the Great Lakes.

- Recommendation on sustainable production research. The experience of the SIMPLE Task Group reinforces the need for additional research on levels of fish harvest that are consistent with sustainable fisheries management. Requests by the Lake Michigan Technical Committee to assist the development of production expectations from the Lake Michigan Fish Community Objectives, however, have revealed a continuing difficulty in the specification of exploitation targets. The need for such targets as part of the delivery of fish community objectives will not be met unless there is a concerted effort to address this issue through an integrated study of the interaction of exploitation (including commercial and recreational harvests) with fish community structure.

The SIMPLE Task Group began as a research project. From a research point-of-view the theoretical components of the research (model building, policy gaming, and experimentation with techniques of adaptive management) have produced promising results, which now must be further prepared for communication. From a management point-of-view, these "scientific" findings offer some interesting possibilities, but technology transfer is far from complete. Computer simulation models are becoming increasingly more valuable to managers. However, there continue to be severe resource constraints (people and time) on agencies to accept full responsibility for the continuation of the SIMPLE initiative. The BOTE has invested substantial resources into the delivery of AEAM process and modeling to the Great Lakes fish management community. In order to maintain this investment, therefore, the Task Group recommends that BOTE consider reintegrating the SIMPLE and IMSL initiatives. The interface between fish management policy and Integrated Management of Sea Lamprey is clearly a priority of the Sea Lamprey Integration Committee. SLIC has arranged for joint meetings of the lake technical committees and control agents. If BOTE could assist the ongoing model development that will be required to make models operational for the lake committees, the joint activity would facilitate the fullest development of sustainable fisheries management in the Great Lakes.

[4] Eshenroder, R. L., C. R. Bronte, and J. W. Peck. (In press). Comparison of lake trout-egg survival at inshore and offshore and shallow-water and deepwater sites in Lake Superior. Paper presented at BOTE Lake Trout Symposium in Ann Arbor, 1994.

APPENDIX I. LISTS OF PARTICIPANTS IN THE WORKSHOPS OF THE SIMPLE TASK GROUP

Participants in the first SIMPLE Workshop, January 8 to 10, 1991, and their institutional affiliation.

Name	Affiliation
Ray Argyle	U.S. Fish and Wildlife Service
Fred Binkowski	University of Wisconsin, Milwaukee
Dave Borgeson	Michigan Department of Natural Resources
Dan Brazo	Indiana Department of Natural Resources
Dieter Busch	U.S. Fish and Wildlife Service
Gavin Christie	Great Lakes Fishery Commission
Glenda Daniel	Lake Michigan Federation
Doug Dodge	Ontario Ministry of Natural Resources
Tom Edsall	U.S. Fish and Wildlife Service
Randy Eshenroder	Great Lakes Fishery Commission
Gary Fahnenstiel	NOAA/Great Lakes Environmental Research Laboratory
Tony Friend	University of Ottawa
John Gannon	U.S. Fish and Wildlife Service
David Gibson	Ontario Federation of Anglers and Hunters
Lorne Greig	Environmental and Social Science Analysts, Ltd.
Michael Hansen	U.S. Fish and Wildlife Service
Richard Hess	Illinois Department of Conservation
Mark Holey	Wisconsin Department of NaturalResources
Rodney Horner	Illinois Department of Conservation
Pat Hudson	U.S. Fish and Wildlife Service
Peter Ihssen	Ontario Ministry of Natural Resources
Michael Jones	Ontario Ministry of Natural Resources
David Jude	University of Michigan
Jim Kitchell	University of Wisconsin, Madison
Joseph Koonce	Case Western Reserve University
Greg Lang	NOAA/Great Lakes Environmental ResearchLaboratory
Robert Lange	New York Department of EnvironmentalConservation
Joe Leach	Ontario Ministry of Natural Resources
Chuck Madenjian	University of Wisconsin, Madison
Ed Mills	Cornell University
Bob O'Gorman	U.S. Fish and Wildlife Service
Brian Potter	Ontario Ministry of Natural Resources
Peter Rand	State University of New York, Syracuse
Tom Stewart	Ontario Ministry of Natural Resources
Bill Taylor	Michigan State University
Dan Thomas	Great Lakes Sport Fishing Council
John Williamson	Ontario Ministry of Natural Resources

Participants in the Second SIMPLE Workshop, April 27-29, 1992, and their institutional affiliation.

Participant Name	Affiliation
Brazo, Dan	Indiana Department of Natural Resources
Christie, Gavin	Great Lakes Fishery Commission
Eshenroder, Randy	Great Lakes Fishery Commission
Friend, Tony	IREE, University of Ottawa
Beggs, Gail	Ontario Ministry of Natural Resources
Gibson, Dave	Ontario Federation of Anglers and Hunters
Hartman, Skip	GLFC, U.S. Advisor for Lake Ontario
Hess, Richard	Illinois Department of Conservation
Hickey, Dennis	Wisconsin Commercial Fishery
Holder, Art	Ontario Ministry of Natural Resources
Holey, Mark	Wisconsin Department of Natural Resources
Jones, Michael L.	Ontario Ministry of Natural Resources
Kettle, Doug	Ontario Charter Boat Association
Knuth, Barbara	Cornell University
Koonce, Joseph F.	Case Western Reserve University
Lange, Bob	NY Dept Environmental Conservation
Lerner, Sally	University of Waterloo
LeTendre, Jerry	NY Dept Environmental Conservation
Meisner, Donald	ESSA
Reynolds, Donald E.	Michigan Department of Natural Resources
Smith, Phil	Ontario Ministry of Natural Resources
Smith, Barry	York University
Stewart, Tom	Ontario Ministry of Natural Resources
Talbot, Mike	Wisconsin Department of Natural Resources
Thomas, Bill	Eastern Lake Ontario Salmon and Trout Assoc.
Thomas, Dan	Great Lakes Sport Fishing Council
Williamson, John	Ontario Ministry of Natural Resources

APPENDIX II. REPORT OF LAKE ONTARIO ROUND TABLE

PROCEEDINGS
SIMPLE LAKE ONTARIO ROUND TABLE

A REPORT OF THE LAKE ONTARIO ROUND TABLE OF THE SIMPLE TASK GROUP ALLISTON, ONTARIO OCTOBER 21-23, 1992

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CONTENTS

SIMPLE PROJECT REVIEW

Sustainability of Intensively Managed Populations in Lake Ecosystems (SIMPLE) is a Task Group of the Board of Technical Experts of the Great Lakes Fishery Commission. By focusing on the intensively managed fisheries of Lakes Michigan and Ontario, the Task Group intends to address issues arising from an ecosystem approach to fisheries management. The guiding purpose of the Task Group is to develop a framework for evaluating the risks of artificially maintained fisheries and, thereby, help managers move Great Lakes fisheries, where possible, to more sustainable configurations.

To guide implementation of the evaluation framework, the Task Group initiated a series of workshops and technical working meetings to develop computer models with which to explore the consequences of fishery management options. The first workshop in January, 1991, produced a detailed conceptual model of Lakes Michigan and Ontario that captured the ecological context of management options. The second workshop, in April 1992, focused on incorporation of social and economic factors into the simulation models and on the preparation for the realistic evaluation of management policies in their full ecological, social, economic, and political context. The final step was the convening a Policy Evaluation Round Table in which managers, user groups, and technical experts could explore alternative management strategies in as realistic fashion as possible. This document is a report of the first of these Round Tables, held in Alliston, Ontario, October 21 to 23, 1992.

PROCEEDINGS OF LAKE ONTARIO ROUND TABLE

Purpose and Goals

The basic purpose of the SIMPLE Task Group's activities is to develop a framework for understanding the impediments to establishing more sustainable fisheries in the intensively managed aquatic communities of Lakes Michigan and Ontario. The Policy Evaluation Round Table is the final step in the process that the SIMPLE Task Group designed for this purpose. The goals of the Round Table were

- to develop a common understanding among participants of the problems confronting management of the fishery resources of Lake Ontario;
- to identify areas of consensus on management strategy;
- to document areas of continuing conflict among stakeholders; and
- to agree on critical uncertainties that constrain wise decision-making.

The guiding principle of the Round Table was that much of the difficulties in setting management policy for Lake Ontario originated in quite different visions among various stakeholders of not only the desired future of the fish community, but also its current state. The central objective of the Round Table, therefore, was to provide a forum and technical tools for the exploration of alternative

Table 1. Participants in the SIMPLE Lake Ontario Round Table, October 21-23, 1992, and their institutional affiliation. A list of all invited participants is in Appendix I.

Participant Name	Affiliation
Bob Beecher	Great Lakes Fishery Commission
Gail Beggs	Ontario Ministry of Natural Resources
Dieter Busch	U.S. Fish and Wildlife Service
Bill Cahil	U.S. Advisor to GLFC
Adele Crowder	Bay of Quinte RAP
Randy Eshenroder	Great Lakes Fishery Commission
Dave Gibson	Ontario Federation of Anglers and Hunters
Vic Gillman	Department of Fisheries and Oceans
Rob Graham	Ontario Fish Producers Association
Lorne Grieg	Environmental and Social Science Analysts, Ltd.
Richard Hess	Illinois Department of Conservation
Art Holder	Ontario Ministry of Natural Resources
Ora Johansson	Department of Fisheries and Oceans
Michael Jones	Ontario Ministry of Natural Resources
Doug Kettle	Ontario Charter Boat Association
Joseph Koonce	Case Western Reserve University
Robert Lange	NY Department of Environmental Conservation
Sally Lerner	University of Waterloo
Robert O'Gorman	U.S. Fish and Wildlife Service
Sandra Orsatti	Ontario Ministry of Natural Resources
Frank Sanza	Lake Ontario Charter Boat Association
Richard Schleyer	U.S. Advisor to GLFC
Phil Smith	Ontario Ministry of Natural Resources
Tom Stewart	Ontario Ministry of Natural Resources
Dan Thomas	Great Lakes Sports Fishing Council
Bill Thomas	Eastern Lake Ontario Salmon and Trout Association
John Williamson	Ontario Ministry of Natural Resources
Chris Wedeles	Environmental and Social Science Analysts, Ltd.
Terry Yonkers	Great Lakes United

points of view and of policies for the management of the fisheries of Lake Ontario.

Round Table Format

The Round Table approach was a gaming process. The 28 participants (Table 1) represented a broad cross-section of invited stakeholder interests (see Appendix 1 for list of invited participants). Facilitated by Grieg and Wedeles of ESSA, the gaming exercise required a scenario management team of the project modellers (Jones and Koonce) with four technical specialists (Johansson, O'Gorman, Stewart, and Williamson) and the remaining participants who assumed various roles as managers or representatives of interests groups. The "role playing" of the participants was central to the gaming process. It was designed to aid each participant in understanding how he or she thought the Lake Ontario fish community worked, to expose areas where logic, individually or collectively, was flawed; to foster an understanding of other points-of-view; and to clarify key uncertainties.

The Round Table began with a plenary discussion in which the participants identified players (interest groups) and their goals. Initially, the facilitators proposed six players: Anglers, Sports Fishing Industry, Environmental Interest Groups, Commercial Fishing Industry, Native North Americans, and Fishery Management Agencies. Participants then split into two subgroups for the development of a strategy for each of the players and analysis of the consequences of the strategy. Table 2 summarizes the iterative character of the analysis of player goals and its timing. Each of the subgroups assumed responsibility for two different players and expanded to additional players as time allowed. The Round Table concluded with a plenary discussion of the findings of each of the

Table 2. Gaming process for analysis of player goals and strategies for managing the fishery resources of Lake Ontario.

Step 1	Strategy Development • Review player goals • Describe short-term (5 yr) strategies • Define expectations for strategies	2 hours
Step 2	Scenario Management Team Runs Scenarios • 5 years into future • Two scenarios (players) per group	1 and 1/2 hours (overlap with step 1)
Step 3	Discuss Scenarios • SMT summarizes results • Subgroup compares expectations and results • Subgroup defines strategy and expectations for another five year period	1 hour
Step 4	Repeat steps 2 and 3 for two more iterations and add additional players for steps 1 to 4 as time permits	3 and 1/2 hours
Step 5	Develop Long-term strategies • Subgroups re-define strategies for all players, but for a minimum 15 year time horizon • SMT runs strategies and presents results	2 hours

subgroups and a synthesis of common understanding, strategic consensus, ongoing conflict, and critical uncertainties.

Players and Goals

Participants identified players and their goals by consensus. The basic idea of the role-playing exercise was to attempt to understand alternative points of view by adopting the perspective of various interests. During discussion of the goals of each player, therefore, all participants were asked to pretend to be a member of that interest group. Representatives of the real interest would help validate the goal statements and clarify any misunderstandings of their positions on vital issues. Because of this key role of interest group representatives, the Round Table could not pursue all of the players that were proposed initially. Sufficient interest group representation was available among participants to pursue five players: Anglers, Sports Fishing Industry, Environmental Interest Groups, Commercial Fishing Industry, and Fishery Management. Unlike the other four players, Fishery Management is not an actual stakeholder. Rather, the Round Table participants pursued the

Table 3. Summary of main goals for the Lake Ontario fish community of players representing various interest groups, as perceived by Round Table participants.

Player	Goals
Anglers	• Maintain local high-quality salmonid fishery • Maintain and promote high quality access facilities
Sports Fishing Industry	• Maintain local high-quality salmonid fishery • Maintain economic benefits associated with fishery • Maintain stability in angling activity • Encourage fishing contests
Environmental Interest Groups	• Sustain healthy Lake Ontario ecosystem • Conservation of native species • Reduce toxic contaminants • Maintain balance among trophic levels in Lake Ontario • Maintain balance of fish size in Lake Ontario
Commercial Fishing Industry	• Maintain diverse fishery and allow by-catch • Lower levels of toxic contaminants • Improve assessment • Improve access to fisheries • Improve partnerships with other groups • Prevent introduction of exotic species • Re-establish native planktivores • Enhance populations of "commercial" species, e.g. yellow perch
Fishery Management	• Achieve sustainable development of fishery resources • Maintain license revenues • Satisfy user groups • Provide inexpensive sources of protein • Coordinate management with water quality and other management agencies

interests of this player from the view of balancing the demands of a variety of stakeholders. Table 3 shows the main goals for each of the five players that participants identified.

Strategies and Consequences

With identification of the goals of each of the five interest groups, participants explored strategies to accomplish them. Starting with a standard worksheet (see Appendix II), each participant developed a strategy and expectations for an interest group. Strategy development was incremental. Through discussion of various approaches, participants first devised a strategy for the next five years. The strategy consisted of a plan for stocking of salmonid predators, harvest and effort regulation, habitat modification, alteration of nutrient loading regime, and introduction of species. While the Scenario Management Team interpreted the scenario and ran the Lake Ontario SIMPLE model, participants developed a set of expectations, which primarily focused on trends in biomass of prey fish, abundance of predators, harvest of predators, fishing effort, and success rates of fishers. Following a report of the Scenario Management Team on the model predictions, participants then revised the strategy for the next ten years as illustrated in Table 2. The participants finished by developing for the interest group a long-term strategy, which best met the group's goals.

Following is a summary of strategies and consequences for each interest group's long-term strategy. However, a common concern of all interest groups was the sustainability of current stocking levels. The scientific understanding of the changes in the Lake Ontario ecosystem had been reviewed by a task group of scientists. Ontario Ministry of Natural Resources and New York Department of Environmental Conservation had produced a brief summary of the task group's report for distribution as part of a public participation process to devise a new management strategy. The workshop began with a review of some of these findings. Although there was substantial disagreement about the severity of the problem, the conclusions of the task group represented the starting point for discussions:

> *"The report of the task group concluded that Lake Ontario has undergone significant declines in productivity during the 1980's. Alewife and smelt populations are in a state of transition to a lower level of production. If the level of predator demand is maintained, an even greater imbalance between demand and supply can be expected. This could drive alewife and smelt abundance even lower and result in poorer growth and lower survival of salmon and trout.*
>
> *An added complication is that the alewife population is also subject to stress from cold water temperatures during severe winters. The stress caused by a deficient food supply makes alewife more vulnerable to the effects of cold*

temperatures. Thus a cold winter would intensify the food chain effects and increase the severity of an alewife decline."[1]

Anglers. The goal of anglers was to maintain the high quality of the current salmonid fishery and to promote high quality access. Without reduction of stocking levels, the model predicted that alewife could not recover from a 50% over-winter mortality in the near term. The best long-term strategy thus had the following components: cut stocking of all species by 50%; require no further decline in nutrient loading, increase lake trout harvest, and increase Chinook harvest by encouraging harvest of smaller fish. Assuming a 50% alewife mortality in the winter of 1992-93, this strategy results in the arresting of the alewife decline while fishing success rates decline by 30% to 35%.

Sports Fishing Industry. The goals of the sports fishing industry reflect those of the anglers, but also include maintaining stability of angling activity. The initial strategy of the group relied on continued stocking and increased fishing effort. As the anglers discovered, this strategy led to collapse of alewife and smelt populations with subsequent depression of Chinook growth that would likely express itself in decreased fish health. A satisfactory long-term strategy proved difficult to derive, however. The group tried a set of staged stocking reduction strategies coupled with modest recovery of fishing effort. It was possible to "stabilize" alewife abundance at low levels, but the population was extremely vulnerable to over-winter mortality. Maintaining a recreational fishery at current harvest and effort levels proved to be a high risk strategy.

Commercial Fishing Industry. The goals of the commercial fishing interest group are different from those of recreational fishery interests. The commercial fishing industry seems to prefer access to historically important native species (such as whitefish, yellow perch, and lake herring). These goals imply a preference for strategies that lower the dominance of alewife, which through competition and predation on larval stages may suppress many of the native planktivores and other species, and that reduce the abundance of top predators. A strategy that reflects this preference would entail reduction of stocking of lake trout and brown trout by 50%, increase harvest of whitefish and tolerance of increased lake trout harvest due to incidental catch. The consequence of this strategy is a continued decline of alewife that may increase the likelihood of good yellow perch, herring, and whitefish year classes.

Environmental Interest Groups. The goals of environmental interest groups are focused more on recovery of healthy ecosystems than on the performance of the fisheries of Lake Ontario. Accordingly, they would prefer strategies that restore native species, reduce toxic contamination, reduction in the threat of eutrophication, and maintain a balance among trophic levels in Lake Ontario. These preferences conflict with the preference of recreational fishery interests for Chinook and coho fisheries supported by abundant alewife. The initial strategy of the gaming group was to

[1] Signs of Change in the Lake Ontario Ecosystem. Anonymous leaflet distributed by the Ontario Ministry of Natural Resources and the New York State Department of Environmental Conservation. Thomas C. Jorling, Commissioner. 50 Wolf Road, Albany, New York 12233.

stop stocking of coho and Chinook, continue to lower nutrient loading, and to decrease lake trout stocking as natural reproduction increased. The result of this strategy was a robust recovery of alewife to the levels of the 1970s and a collapse of the recreational fishery for salmon. Although no preferable long-term strategy emerged, more modest stocking reductions appear to be required to lower alewife abundance sufficiently to allow recovery of native species. The transition to a recovered Lake Ontario ecosystem could continue to provide recreational and commercial fishing opportunity, but preserving alewife at a stable, low-density condition required to support the recreational fishery is difficult given the uncertainties surrounding over-winter mortality of alewife.

Fishery Management. The basic goal of fishery managers is to provide a sustainable fishery in Lake Ontario. This goal requires balancing predator and prey abundance within constraints of reasonable levels of sports and commercial harvest and recreational fishing effort. Success of the current recreational fishery is also important to preserve. The main elements of a strategy to accomplish these goals is to maintain effort recovery while reducing stocking of predators. Through analysis of various scenarios, it seemed possible to lower stocking sufficiently to stabilize prey at low biomass levels following an over-winter die-off of alewife. A key question is how to distribute stocking reductions among predator species. Below is a contrast between two possible approaches that stabilize prey biomass at about the same levels.

Strategy	**Outcome**
Stocking Reduction: 75% Chinook 20 % all other species	Individual Stock Declines: 75% Chinook 0% coho and rainbow 20 % lake trout and brown trout Fishable Stock Decline: 67%
Stocking Reduction: 10% Chinook 100% all other species	Individual Stock Declines: 10% Chinook 60% Rainbow 60% coho and rainbow 80% brown trout 60% lake trout Fishable Stock Decline: 48%%

FINDINGS OF LAKE ONTARIO ROUND TABLE

The primary objective of the Lake Ontario Round Table was to explore alternative points of view and of policies for the management of the fisheries of Lake Ontario. The round-table format coupled with a model of the Lake Ontario fish community provided an opportunity for individuals with diverse points-of-view to explore the consequences of their understanding of and preferences for future management of the fisheries. To varying degrees, the workshop achieved the four goals established by the SIMPLE Task Group. Participants left with a better understanding of the problems confronting management of the fisheries resources. This improved common understanding did lead to some consensus on fundamental issues, but important areas of fundamental disagreement also became apparent. Some of these disagreements were factual in nature. These, however, are possible to resolve with more focused research and monitoring, with further analysis of available data, or with future results of ongoing assessment by management agencies. Other disagreements represent fundamental differences of preference for the state of the fish community as well as the performance of recreational and commercial fisheries. The following paragraphs deal more specifically with areas of consensus, remaining uncertainties, and general conclusions and recommendations that emerged from the round table.

Areas of Consensus

Although knowledge of the exact state of the alewife population remains ambiguous, a major consensus of the round table was that current stocking levels are creating a predator-prey imbalance in Lake Ontario. Given the tendency of alewife populations to suffer periodic die-offs, continuation of stocking at recent levels involves accepting a high risk of collapse of the prey biomass, especially given the declining productivity of Lake Ontario due to improvements in water quality. Participants agreed that continuation of recent policies may no longer be advisable. Although there was agreement that corrective actions needed to begin as soon as possible, the only consensus that emerged was for a process of incremental decreases in stocking with magnitude dependent on future analysis and assessment.

Consensus also emerged for a continuation of the type of dialogue that occurred during the round table. An important impetus for this consensus was the recognition that various stakeholders have fundamentally different long-term goals for Lake Ontario. Long-term objectives for the state of the Lake Ontario ecosystem are necessary for public acceptance of management decisions and for the coordination of management initiatives among agencies and jurisdictions. Yet these objectives remain unclear. Partly, participants recognized that this goal setting is not solely within the domain of responsibility of fishery managers. The round table format must extend to local government and

include more expertise on the economic consequences of various policy options. To establish long-term objectives requires a thoughtful evaluation of the consequences of preferences of various stakeholders and of the implicit trade-offs of interests and uses that are required to implement the objectives. A timely, iterative, and open process would seem to be required to achieve this end.

Key Uncertainties

Although the fish community model provided an objective basis for exploring consequences of various policy options, some key uncertainties limited the confidence that participants could place in specific recommendations of stocking policies and harvest goals. Participants recognized the need for better information on the status of alewife in Lake Ontario and also recognized the importance of the limited understanding of the Lake Ontario ecosystem. Three specific areas of uncertainty were "bottom-up" effects of reductions in phosphorus loading, the relationship of mortality and growth rate in predator populations, and the formal inclusion of stochastic processes such as periodic alewife die-offs in the evaluation of risks of policy options. The accuracy of the model used in the gaming phase of the round table was limited by these uncertainties. Future use of the model will require a continuation of an open and comprehensive approach to its testing and to improvements in understanding of fundamental ecological processes in Lake Ontario.

Conclusions

In that the goals of the SIMPLE Task Group had been met, the Lake Ontario Round Table was a success. More generally, however, the success of the round table was its contribution to a broader initiative of Ontario Ministry of Natural Resources and New York's Department of Environmental Conservation to enter into a broad and open public consultation process for deciding upon future management actions. Participants valued the availability of a "gaming" model with which to understand and explore the implications of the actions of management agencies. Despite limitations of accuracy, the model did impose a requirement for consistency of understanding of the Lake Ontario ecosystem. Trial-and-error learning with the model led not only to realization of the fundamental limitations of understanding of the Lake Ontario ecosystem, but also to the realization that individual preferences and the understanding upon which they are based also have limitations. The value of the model and the round table process was that it allowed various stakeholders to achieve common understanding of the problems confronting fishery managers, to separate differences of opinion about factual and policy preference issues, and to understand the trade-offs imposed on other stakeholders for preferred policy options.

Participants agreed that a round table process for Lake Ontario should continue. Much discussion focused on how this process could be coupled with the public consultation process that

New York and Ontario were about to start in the fall of 1992. Suggestions and recommendations for future activity included:

- Participation should be expanded to include business and local government interests;
- An openly accessible model should be available for public discussions where many scenarios can be explored;
- There should be less reliance on a "Scenario Management Team" to interpret model results and more direct reliance on graphical output from the model; and
- Efforts must be made to expand the limited technical expertise with the model beyond the SIMPLE task leaders.

APPENDIX I. INVITED PARTICIPANTS, LAKE ONTARIO ROUND TABLE

Name	Affiliation
Bob Beecher	Great Lakes Fishery Commission
Gail Beggs	Ontario Ministry of Natural Resources
Gary Blundell	Canadian Wildlife Federation
Dieter Busch	U.S. Fish and Wildlife Service
Bill Cahil	U.S. Advisor to GLFC
Adele Crowder	Bay of Quinte RAP
Randy Eshenroder	Great Lakes Fishery Commission
Dave Gibson	Ontario Federation of Anglers and Hunters
Vic Gillman	Department of Fisheries and Oceans
Rob Graham	Ontario Fish Producers Association
Lorne Grieg	Environmental and Social Science Analysts, Ltd.
Skip Hartment	U.S. Advisor, Great Lakes Fishery Commission
Richard Hess	Illinois Department of Conservation
Earl Hill	Chief, Tyendinega Reserve
Art Holder	Ontario Ministry of Natural Resources
Ora Johansson	Department of Fisheries and Oceans
Michael Jones	Ontario Ministry of Natural Resources
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Robert Lange	NY Department of Environmental Conservation
Sally Lerner	University of Waterloo
Chris Lompart	Federation of Ontario Naturalists
Rebecca McKenzie	Ontario Ministry of Natural Resources
Robert O'Gorman	U.S. Fish and Wildlife Service
Sandra Orsatti	Ontario Ministry of Natural Resources
Gord Peters	Chiefs of Ontario
Frank Sanza	Lake Ontario Charter Boat Association
Richard Schleyer	U.S. Advisor, Great Lakes Fishery Commission
Bruce Schupp	New York Department of Environmental Conservation
Phil Smith	Ontario Ministry of Natural Resources
Tom Stewart	Ontario Ministry of Natural Resources
Dan Thomas	Great Lakes Sports Fishing Council
Bill Thomas	Eastern Lake Ontario Salmon and Trout Association
John Williamson	Ontario Ministry of Natural Resources
Chris Wedeles	Environmental and Social Science Analysts, Ltd.
Terry Yonkers	Great Lakes United

APPENDIX II. WORKSHEET FOR SCENARIO DESCRIPTION

Scenario Description

Player:

Goal:

Strategy

Stocking

- Lake Trout
- Coho
- Chinook
- Rainbow
- Brown

Harvest

Effort

Habitat

Nutrients

Introductions

Expectations

Biomass of prey fish

Predators

Abundance

Harvest

- Lake Trout
- Coho
- Chinook
- Rainbow
- Brown

Success rates

Effort

APPENDIX III. REPORT OF LAKE MICHIGAN ROUND TABLE

PROCEEDINGS
SIMPLE LAKE MICHIGAN ROUND TABLE

A REPORT OF THE LAKE MICHIGAN ROUND TABLE OF THE SIMPLE TASK GROUP WINGSPREAD CONFERENCE RACINE, WISCONSIN JANUARY 19-21, 1993

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June 1993

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CONTENTS

SIMPLE PROJECT REVIEW

Sustainability of Intensively Managed Populations in Lake Ecosystems (SIMPLE) is a Task Group of the Board of Technical Experts of the Great Lakes Fishery Commission. By focusing on the intensively managed fisheries of Lakes Michigan and Ontario, the Task Group intends to address issues arising from an ecosystem approach to fisheries management. The guiding purpose of the Task Group is to develop a framework for evaluating the risks of artificially maintained fisheries and, thereby, help managers move Great Lakes fisheries, where possible, to more sustainable configurations.

To guide implementation of the evaluation framework, the Task Group initiated a series of workshops and technical working meetings to develop computer models with which to explore the consequences of fishery management options. The first workshop in January, 1991, produced a detailed conceptual model of Lakes Michigan and Ontario that captured the ecological context of management options. The second workshop, in April 1992, focused on incorporation of social and economic factors into the simulation models and on the preparation for the realistic evaluation of management policies in their full ecological, social, economic, and political context. The final step was the convening a Policy Evaluation Round Table in which managers, user groups, and technical experts could explore alternative management strategies in as realistic fashion as possible. This document is a report of the second of these Round Tables, which was sponsored for Lake Michigan by the Johnson Foundation at Wingspread in Racine, Wisconsin, January 19 to 21, 1993.

PROCEEDINGS OF LAKE MICHIGAN ROUND TABLE

Purpose and Goals

The basic purpose of the SIMPLE Task Group's activities is to develop a framework for understanding the impediments to establishing more sustainable fisheries in the intensively managed aquatic communities of Lakes Michigan and Ontario. The Policy Evaluation Round Table is the final step in the process that the SIMPLE Task Group designed for this purpose. The goals of the Round Table were

- to develop a common understanding among participants of the problems confronting management of the fishery resources of Lake Ontario;
- to identify areas of consensus on management strategy;
- to document areas of continuing conflict among stakeholders; and
- to agree on critical uncertainties that constrain wise decision-making.

The guiding principle of the Round Table was that much of the difficulties in setting management policy for Lake Michigan originated in quite different visions among various stakeholders of not only the desired future of the fish community, but also its current state. The central objective of the Round Table, therefore, was to provide a forum and technical tools for the exploration of alternative points of view and of policies for the management of the fisheries of Lake Michigan.

Table 1. Participants in the SIMPLE Lake Michigan Round Table, January 19-21, 1993, and their institutional affiliation. A list of all invited participants is in Appendix I.

Participant Name	Affiliation
Ron Anton	Wisconsin Federation of Great Lakes Sport Fishing Clubs
Glenda L. Daniel	Lake Michigan Federation
Randy Eshenroder	Great Lakes Fishery Commission
Thomas Gorenflo	Chippewa/Ottawa Treaty Fishery management Authority
Dennis Grinold	Michigan Charter Boat Association
Michael J. Hansen	U.S. Fish and Wildlife Service
Richard Hess	Illinois Department of Conservation
Dennis Hickey	Wisconsin Commercial Fishery
Mark E. Holey	U.S. Fish and Wildlife Service
William H. Horns	Wisconsin Department of Natural Resources
Lee T. Kernen	Wisconsin Department of Natural Resources
James Kitchell	University of Wisconsin-Madison
Barbara Knuth	Cornell University
Edward J. Makauskas	U.S. Advisor, Great Lakes Fishery Commission
Edward J. Michael	Illinois Council of Trout Unlimited
Christine Mitchell	Grand Traverse Band of Ottawa/Chippewa Indians
Michael J. Ryan	Great Lakes Sport Fishing Council
Kelley Smith	Michigan Department of Natural Resources
Michael J. Talbot	Wisconsin Department of Natural Resources
Dan Thomas	Great Lakes Sport Fishing Council
E. John Trimberger	Michigan Department of Natural Resources
John Williamson	Ontario Ministry of Natural Resources
Terry L. Yonkers	Great Lakes United

Round Table Format

The Round Table approach was a gaming process. The 23 participants (Table 1) represented a broad cross-section of invited stakeholder interests (see Appendix 1 for list of invited participants). Facilitated by Greig and Wedeles of ESSA, the gaming exercise required a scenario management team of the project modelers (Jones and Koonce) with four technical specialists (Smith,

Holey, Kitchell, Williamson) and the remaining participants who assumed various roles as managers or representatives of interests groups. The "role playing" of the participants was central to the gaming process. It was designed to aid each participant in understanding how he or she thought the Lake Michigan fish community worked, to expose areas where logic, individually or collectively, was flawed; to foster an understanding of other points-of-view; and to clarify key uncertainties.

The Round Table began with a plenary discussion in which the participants identified players (interest groups) and their goals. Initially, the facilitators proposed six players: Anglers, Sports Fishing Industry, Environmental Interest Groups, Commercial Fishing Industry, Native North Americans, and Fishery Management Agencies. Participants discussed the possible omission of interests of lake shore communities and other water users (municipalities, boaters, and industry). Inclusion of the interests of lake shore communities explicitly in the "sports fishing industry" player group seemed a reasonable compromise, but other water users, particularly industry and municipalities, which are "raw" water users, would require an interest group specification of their own. Following preliminary review of the goals of each of these interest groups, participants then split into two subgroups for the development of a strategy for each of the players and analysis of the consequences of the strategy. Table 2 summarizes the iterative character of the analysis of player goals and its timing. Each of the subgroups assumed responsibility for two different players and expanded to additional players as time allowed. The Round Table concluded with a plenary

Table 2. Gaming process for analysis of player goals and strategies for managing the fishery resources of Lake Michigan.

Step 1	Strategy Development • Review player goals • Describe short-term (5 yr) strategies • Define expectations for strategies	2 hours
Step 2	Scenario Management Team Runs Scenarios • 5 years into future • Two scenarios (players) per group	1 and 1/2 hours (overlap with step 1)
Step 3	Discuss Scenarios • SMT summarizes results • Subgroup compares expectations and results • Subgroup defines strategy and expectations for another five year period	1 hour
Step 4	Repeat steps 2 and 3 for two more iterations and add additional players for steps 1 to 4 as time permits	3 and 1/2 hours
Step 5	Develop Long-term strategies • Subgroups re-define strategies for all players, but for a minimum 15 year time horizon • SMT runs strategies and presents results	2 hours

discussion of the findings of each of the subgroups and a synthesis of common understanding, strategic consensus, ongoing conflict, and critical uncertainties.

Players and Goals

Table 3 shows the main goals for each of the seven players that participants identified. They identified players and their goals by consensus. The basic idea of the role-playing exercise was to attempt to understand alternative points of view by adopting the perspective of various interests. During discussion of the goals of each player, therefore, all participants were asked to pretend to be

Table 3. Summary of main goals for the Lake Michigan fish community of players representing various interest groups, as perceived by Round Table participants.

Player	Goals
Sports Fishing Industry	• Diversified, stable fishery • Consistent catch • Satisfied anglers
Commercial Fishing Industry	• Multi-species fishery (whitefish, perch, lake trout, and other native species) • Multi-gear fisheries to minimize by-catch of non-target species and to allow flexibility for year-round fishery • Control of sea lamprey • High, but sustainable harvest • Contaminant reduction • Habitat protection
Environmental Interest Groups	• Diverse, healthy ecosystem • Reduced reliance on stocking through improvement of habitat to allow more natural reproduction, i.e. emphasis on obtaining self-sustaining populations in fish community • Diversity of economies of nearshore communities to broaden use of lake • Protection of diverse habitats • Reduced contamination • Restoration of native fish community
Native North Americans	• Multi-species, multi-gear, year-round fishery • Maintenance of subsistence fishery • Emphasis on traditional (i.e. native) species mix • Maintenance of fishing opportunity for future generations • Restoration and re-introduction of depressed native species (e.g. lake sturgeon)
Anglers	• Diversity of fishing opportunity, i.e. diverse species mix • Quality fishing experience (size and number of fish caught) • Diversity of fishing locations (shore fisheries, offshore, and inshore) • Aesthetically pleasing fishing experiences with emphasis on natural features • Edible fish, contaminant free • Restoration of and access to stream and river fisheries
Raw Water Users	• Reduced impact of fish communities on water intake structures • Fish community structure that minimizes the adverse impacts of water intake and cooling water discharge • Control of nuisance, exotic species
Fishery Management Agencies	• Protect fish communities for the future • Maintain the revenue base for resource management agencies • Balance expenditures for fishery management relative to other governmental expenditures • Re-establishment of rare and endangered species • Manage for sustainable fisheries

a member of that interest group. Representatives of the real interest would help validate the goal statements and clarify any misunderstandings of their positions on vital issues. Only the raw water users (electric power utilities, municipalities, and various industries) were not sufficiently represented to pursue their goals. Except for fishery management, participants were able to explore management preferences and consequences for the other groups. Unlike these other players, however, fishery management is not an actual stakeholder. Rather, the Round Table participants pursued the interests of this player from the view of balancing the demands of a variety of stakeholders against their stewardship responsibilities and public accountability.

Strategies and Consequences

A central problem affecting strategies of all interest groups is the difficulty of reversing the declining trend of alewife in Lake Michigan. Pursuing the goals of environmental interests, for example, results in a strategy that enhances native species and reduces stocking. Implementation of this strategy, however, is beset with uncertainties and limitations on the scope of realistic management options. Although the alewife decline may be desirable in that it will be easier to reestablish native planktivores, the recovery of native species like bloater may not continue if stocking remains at current levels. Furthermore, it seems that rather substantial wild production of coho, Chinook, and rainbow trout and the dramatic increase in abundance of burbot may limit options to drastically alter predation intensity in Lake Michigan. Nevertheless, restoration of lake trout continues to be constrained by problems in obtaining wild production and stocking must continue.

The future of alewife also affects interests of Native American and commercial fishing groups. Their goals as well imply a preference for a diverse mix of species such as whitefish, yellow perch, and lake trout that may not be consistent with high alewife abundance necessary to sustain an intense recreational fishery for non-indigenous trout and salmon. Stocking cuts of predators seemed to be required to prevent a reversal of the recovery of bloater chubs, but as with the environmental interests, key uncertainties about the extent of natural reproduction of coho and Chinook salmon and rainbow trout and the actual abundance of alewife limit confidence in proposed solutions.

Anglers and the sports fishing industry share goals of restoring high quality recreational fisheries. Although Chinook is a featured species, the recreational fishery interests also seek diversity of species and accessibility of fishing opportunities. Unless, older Chinook are able to feed on larger chubs, however, the desired mix of species depends upon reversal of the alewife decline. From simulations, it was not clear that the alewife decline could be reversed without virtual elimination of all stocking. If the model is basically correct, the recreational fishery must readjust its preference for species mix with little or no prospect for an alewife recovery. If the model in incorrect (i.e. the alewife abundance has not declined as far as predicted), then moderate reductions in

stocking might be sufficient to prevent the demise of alewife. Even in this case, however, the policy resulting in lowest risk relative to possible benefits would appears to be to reduce stocking, particularly of Chinook, which has the highest demand for alewife.

These findings offer fishery managers the opportunity to redirect management strategy for Lake Michigan away from reliance on stocking to maintain high quality fisheries. Although its reversibility is uncertain, the decline of alewife is clearly consistent with an imbalance of predator abundance and prey production. To some extent, the decline in abundance of Chinook is associated with the extreme preference of Chinook for alewife as a primary prey item. Because only lake trout and brown trout show no evidence of natural reproduction, more dependence on enhancement of self-sustaining stocks and stocking directed toward overcoming limitations on lake trout reproduction seems to offer a way of rebalancing predator and prey populations in Lake Michigan. Accepting the demise of alewife would imply lower abundance of Chinook salmon, but natural production could provide a better basis for predator populations to adjust to prey production. Continued primary reliance on stocking to provide fishing opportunities for recreational fisheries poses substantial risks to stability of the fishery as does reliance on semelparous species (Chinook and coho salmon), which die after achieving reproductive maturity, versus iteroparous species (rainbow trout and lake trout).

FINDINGS OF LAKE MICHIGAN ROUND TABLE

The primary objective of the Lake Michigan Round Table was to explore alternative points of view and of policies for the management of the fisheries of Lake Michigan. The round-table format coupled with a model of the Lake Michigan fish community provided an opportunity for individuals with diverse points-of-view to explore the consequences of their understanding of and preferences for future management of the fisheries. To varying degrees, the workshop achieved the four goals established by the SIMPLE Task Group. Participants left with a better understanding of the problems confronting management of the fisheries resources. This improved common understanding did lead to some consensus on fundamental issues, but important areas of fundamental disagreement also became apparent. Some of these disagreements were factual in nature. These, however, are possible to resolve with more focused research and monitoring, with further analysis of available data, or with future results of ongoing assessment by management agencies. Other disagreements represent fundamental differences of preference for the state of the fish community as well as the performance of recreational and commercial fisheries. Discussions revealed the following areas of consensus and conflict and key uncertainties that hinder consensus building.

Areas of Consensus and Conflict

Participants agreed generally on three major points. First, the future of alewife in Lake Michigan is doubtful. The declining trend in alewife consistent with a predator-prey imbalance, and, given that there seems to be little reasonable possibility to reverse the decline, an objective of increasing alewife biomass does not appear realistic or desirable. Second, natural reproduction is already a significant contribution to predator populations in Lake Michigan. There is a need, therefore, to further improve spawning habitat in tributaries throughout the drainage basin. Habitat restoration could reduce even more the reliance on stocking to provide fishing opportunity. Because lake trout reproduction is a sensitive indicator for off-shore habitat quality, continuation of efforts to restore self-sustaining lake trout populations is not in conflict with maintaining self-sustaining populations of tributary spawning species. Finally, the decline of alewife offers new opportunities for planning about the future of the Lake Michigan fish community. Goals for the sustainable use of the fish resources are not in conflict with goals of restoring native species.

Important differences in priorities for long-term management and differences in preference for short-term decisions also were apparent. Although the goals of sustainable use and goals of restoration of native species were not in conflict, the preferences for the quantitative composition of the fish community were. The recreational fishery has a strong preference for Pacific salmonids over lake trout. The preference for a specific mix of species, however, is difficult to justify given the range of uncertainties about future adjustments in diet of Chinook salmon and the status and fate of the alewife population. Additional information and dialogue will be needed to resolve this conflict. Preferences on short-term adjustments to stocking decision making are also in conflict. Again, there seems agreement that stocking cuts will be needed, but not on the mix of those cuts or on their size. The key question is how much to reduce Chinook stocking, and the answer rests, in part, on better understanding of the BKD incidence in Chinook populations and on the relation between BKD incidence and growth rate.

Key Uncertainties

The major uncertainties discussed by participants included both factual matters and fundamental uncertainties about future behavior and biological responses of the fish community. Among the factual uncertainties were

- Current "whole-lake" biomass of alewife,
- Current natural production of salmonids,
- Causation of BKD mortality of Chinook, nutrition or epizootic?, and
- Post-stocking survival of salmonids.

Behavioral and other biological characteristics that are difficult to predict include:

- Will the diet of Chinook salmon shift to chubs with further decline of alewife?

- Will the survival of Chinook be affected by diet shifts accompanying changes in the prey species mix of Lake Michigan?
- How have changes in nutrient loading and how will future invasion of zebra mussels affect food-chain stability?

Conclusions

Participants found the Round Table to be a worthwhile exercise. The opportunity to exchange points-of-view before decisions were made was especially helpful to non-agency participants. Fish managers, in fact, were able to use the Round Table as a sounding board for public concerns with the consequences of management options that would be preferred by a wide range of interest groups. Non-agency participants too benefited from an open forum in which they could see their preferences for resource use balanced against the interests and needs of other groups. Participants recommended that fish managers try to find a way of institutionalizing the Round Table process show that there would be more frequent use of partnerships in developing management decisions.

The use of a model in the Round Table also seemed beneficial. Key uncertainties and model complexity, however, require more thorough work if the technical basis of decision-making is to improve and become more credible. There was a recommendation that the SIMPLE task force continue with this partnership consultation. The value of continued model building, coordination of modeling efforts and data analysis, and continued consultation with a mix of interest groups would promote the type of communication among managers, technical specialists, and members of the public that will be required for more consensus based forms of management.

APPENDIX I. INVITED PARTICIPANTS, LAKE MICHIGAN ROUND TABLE

Name	Affiliations
Anton, Ron	U.S. Advisor, Great Lakes Fishery Commission
Bernard Bouschor	Chippewa/Ottawa Treaty Fishery Management Authority
Brah, William	Center for Great Lakes
Conlin, Mike	Illinois Department of Conservation
Daniel, Glenda	Lake Michigan Federation
Darwin, Jack	Sierra Club
Donahue, Mike	Great Lakes Commission
Ebener, Mark	Chippewa/Ottawa Treaty Fishery Management Authority
Eshenroder, Randy	Great Lakes Fishery Commission
Gorenflo, Tom	Chippewa/Ottawa Treaty Fishery Management Authority
Grinold, Dennis	Michigan Charter Boat Association
Hansen, Michael	U.S. Fish and Wildlife Service
Hess, Richard	Illinois Department of Conservation
Hickey, Dennis	Wisconsin Commercial Fishery
Hudson, Gary	Indiana Department of Natural Resources
James, William	Indiana Department of Natural Resources
Kernan, Lee	Wisconsin Department of Natural Resources
Knuth, Barbara	Cornell University
Makauskas, Ed	U.S. Advisor, Great Lakes Fishery Commission
McNulty, Tim	Council of Great Lakes Governors
Michael, Ed	Illinois Council of Trout Unlimited
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Raphael, Joseph	Grand Traverse Band of Chippewa Indians
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Smith, Kelley	Michigan Department of Natural Resources
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Talbot, Mike	Wisconsin Department of Natural Resources
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APPENDIX II. WORKSHEET FOR SCENARIO DESCRIPTION

Scenario Description

Player:

Goal:

Strategy

Stocking

- Lake Trout
- Coho
- Chinook
- Rainbow
- Brown

Harvest

Effort

Habitat

Nutrients

Introductions

Expectations

Biomass of prey fish

Predators

Abundance

Harvest

- Lake Trout
- Coho
- Chinook
- Rainbow
- Brown

Success rates

Effort