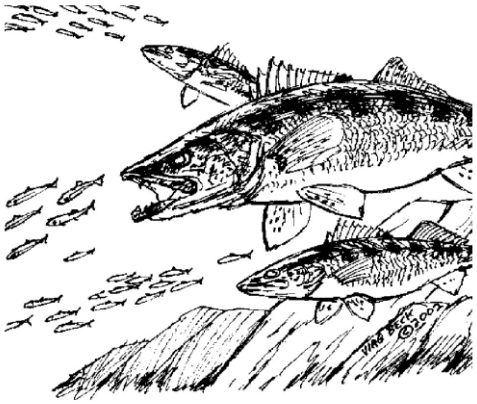
A REHABILITATION PLAN FOR WALLEYE POPULATIONS AND HABITATS IN LAKE SUPERIOR



Great Lakes Fishery Commission

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May 2003

A REHABILITATION PLAN FOR WALLEYE POPULATIONS AND HABITATS IN LAKE SUPERIOR

edited by

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ABSTRACT

The walleye (*Stizostedion vitreum vitreum*) has been historically important in regional fisheries and fish communities in large bays, estuaries, and rivers of Lake Superior. Significant negative impacts on the species caused by overharvesting, habitat degradation, and pollution during the late 1800s and early 1900s have led to the preparation of a strategic rehabilitation plan. The lakewide goal is to maintain, enhance, and rehabilitate habitat for walleye and to establish self-sustaining populations in areas where walleyes historically lived. Population objectives that support the goal are to increase the abundance of juvenile and adult walleyes in selected areas. Habitat objectives that support the goal include increasing spawning and nursery habitat in four areas: enhancing fish passage, reducing sedimentation, increasing water quality, and reducing contaminants in walleyes. Progress toward achieving the habitat objectives should be measured by documenting increases in spawning and nursery habitats, resolving fish-passage issues, reducing sediments in rivers, and reducing contaminant levels in walleyes. Stocking various life stages of walleye should be considered to rehabilitate certain degraded populations. Total annual mortality of walleye populations should be less than 45% to allow populations to either increase or be maintained at target levels of abundance. Routine assessments should focus on gathering the data necessary to evaluate abundance and mortality and on taking inventories of spawning and nursery habitats. Research should be conducted to understand the specific habitat requirements for Lake Superior walleye populations and the habitat-abundance relationships for populations and for the lake as a whole.

INTRODUCTION

The walleye (*Stizostedion vitreum vitreum*) was important in regional fisheries (Hoff 1996) and fish communities (e.g., Hoff and Bronte 1999) in large bays, estuaries, and rivers of Lake Superior in the late 1800s and the early 1900s. However, recent overharvesting, habitat degradation, poor land-use practices, river damming, and pollution have caused declines in walleye populations and degradation of their habitats in the first half of the 20th century (Hoff 1996). To aid in managing the Great Lakes as an ecosystem, *A Joint Strategic Plan for Management of Great Lakes Fisheries* (Great Lakes Fishery Commission 1997) was developed. The plan required development of fish-community objectives to provide a framework to rehabilitate degraded or lost fishery resources. The objectives developed for Lake Superior in response to the plan (Busiahn 1990) were to:

- "Manage exploitation of nondepleted stocks to maintain a stable, self-sustaining status for...walleye"

- "Achieve no net loss of the productive capacity of habitats supporting Lake Superior fisheries, restore the productive capacity of habitats that have suffered damage, and reduce contaminants in all fish species to levels below consumption advisory levels"

The Lake Superior Technical Committee (LSTC), working under the direction of the Lake Superior Committee (LSC), recognized a need for a plan to rehabilitate walleye populations and habitats in the lake but also realized that too few data were available to develop such a plan. Therefore, the LSTC formed a Walleye Subcommittee and charged it to:

1. Report on the status of walleye populations in the lake

2. Draft a rehabilitation plan

Hoff's (1996) report on the status of walleye populations indicated that most of the historically large populations in the lake had experienced population reductions, habitat losses, or habitat degradations. Additionally, the Black Bay and Nipigon Bay populations—historically, two of the largest populations in Lake Superior (Ryder 1968; Schneider and Leach 1977; Kelso et al. 1996)—had been nearly extirpated.

Insufficient historic data for certain populations make it impossible to develop rehabilitation programs that are empirically based. Consequently, rehabilitation programs for some walleye populations and habitats have followed either recommendations of minimum effective population size (Billington 1996) or goals set by fishery managers.

The following historical account by Goode (1884) is valuable because it describes rare information on relative abundance of walleyes in fisheries across United States jurisdictions:

> *At the western extremity of Lake Superior, at the head of Saint Louis Bay, wall-eyed Pike are abundant. They are there taken extensively with seines. Off the Wisconsin coast of Lake Superior, and, passing east, as far as Ontonagon, Michigan, Pike have, within the last two years, become abundant. Four years ago the fishermen could scarcely find sufficient for their own tables, while in 1879 there was an immense "run" of Pike. They are most abundant in Squaw and Siscourt Bays and are of larger size than in Keweenaw Bay. The sudden appearance of Pike is a deep puzzle to the fishermen.*
>
> *At Portage Entry and L'Anse, Pike are abundant; they are common, however, all along the shore from Ontonagon to Huron Bay, between which two points they rank third, and would take the second place (i.e., that of lake trout) if the "runs" of Pike were as continuous as those of trout—which latter can be caught at all times. Pike are here taken principally in the pounds. They average a smaller size than in the Lower Lakes. At Portage Entry the fishermen used to keep the Pike in a pond until required for shipment. They are here called "Yellow Pike."*
>
> *On the fishing grounds between Grand Island and Sauk's Head, including Ontario Bay, Sucker Bay, Laughing-fish Point, Short Point, Marquette and Big Presque Isle, Pike are taken to some extent, but are not abundant enough to be of much importance. Twelve years ago they were quite rare; they have since that time been increasing steadily. They are taken in the pound-nets to some extent, but rarely in the gill-nets. Some pounds do not get half a dozen to a lift. In this region they are known as "Yellow Pike," as also at White-fish Point, where they are sometimes taken at the rate of two or three hundred pounds at a lift, but are not plentiful.*

Individual jurisdictions and/or management agencies have prepared management plans that describe their policies for walleye populations and habitats (Ontario Ministry of Natural Resources 1986; Wisconsin Department of Natural Resources 1988; Newman et al. 1991; Ontario Ministry of Natural Resources 1994; Schreiner 1995). The objective of this plan is to propose guidelines that can aid interjurisdictional coordination for rehabilitating important walleye populations and habitats in Lake Superior. This plan should be periodically revised as new information and data show progress toward, or achievement of, rehabilitation objectives. Also, strategies delineated in this plan may need modification as results are evaluated and reported. Rehabilitation of walleye populations and habitats will take many years. For example, stocking walleye may eventually result in reestablished, self-sustaining populations, but walleyes do not typically mature until at least age 6 (Schram et al.). Many years of stocking may be needed to build an adult population that is large enough to produce recruits adequate for a self-sustaining population at the target level. It is anticipated that the success of many of the strategies outlined in this plan cannot be evaluated in less than 10 years. Instead, success of the strategies incorporated in this plan can probably be best judged after at least 10-20 years.

MANAGEMENT AREAS

The appropriate spatial units for rehabilitation of walleye populations and habitats are either:

- Individual populations or habitats

- Political jurisdictions

This plan describes important issues, objectives, and strategies regarding rehabilitation of individual populations or habitats. The walleye populations and habitats selected for rehabilitation (Fig. 1) can be combined into jurisdictions for management.

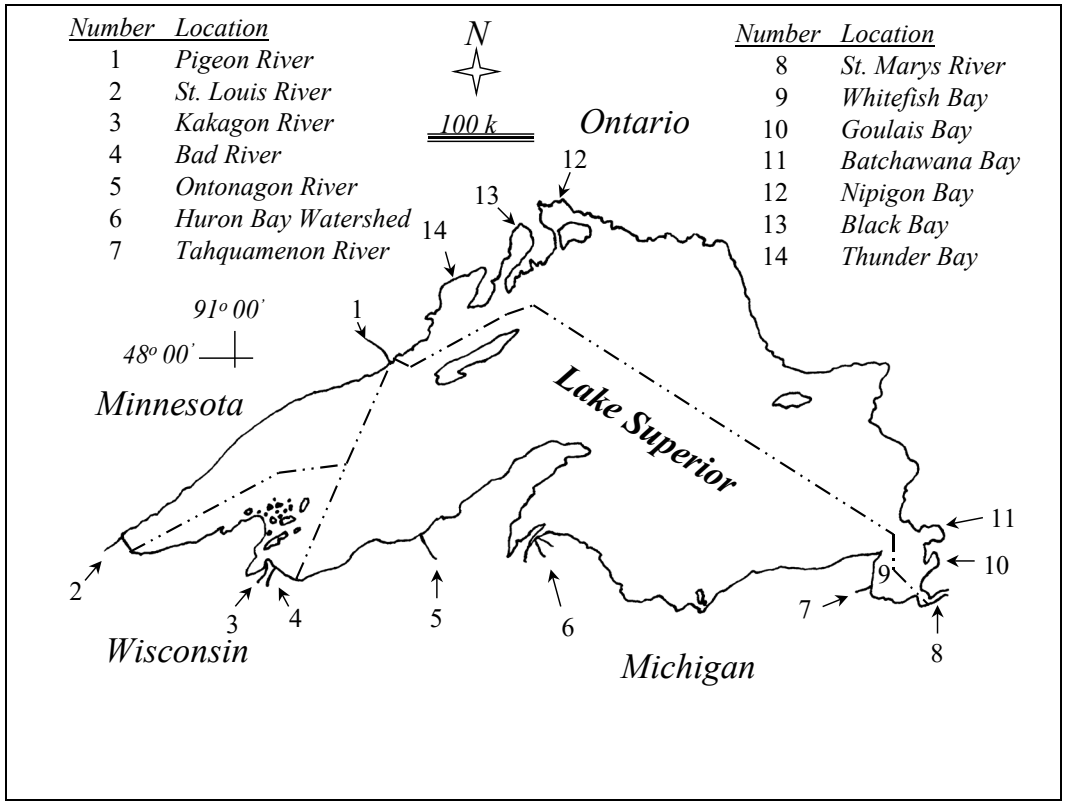

Fig. 1. Location of Lake Superior walleye populations and habitats in need of rehabilitation.

OBJECTIVES FOR REHABILITATION

Walleye populations and habitats selected for rehabilitation met three criteria:

- The population existed historically
- The population declined
- The management agencies with the jurisdiction were committed to rehabilitation

Walleye habitats were selected for rehabilitation if local management agencies either documented or agreed that degradation or loss had occurred in a particular watershed.

The walleye objectives outlined in the fish-community objectives for Lake Superior (Busiahn 1990) were to:

- Manage the exploitation of nondepleted stocks to maintain a stable, self-sustaining status
- Reestablish depleted stocks

The LSC wished to develop more-quantifiable and specific rehabilitation goals that were more compatible with the objectives of the Lake Superior Binational Program. The LSC, LSTC, and the Walleye Subcommittee members operate under the auspices of the Great Lakes Fishery Commission and provide linkage to the Binational Program. The Binational Program objective for aquatic communities states that the lake should sustain diverse, healthy, reproducing, and self-regulating aquatic communities closely representative of historical conditions (Lake Superior Work Group, 1998). The Binational Program ecosystem objectives further recommend that:

- Native aquatic species associations be recognized as key elements of a healthy Lake Superior ecosystem
- Degraded habitat features be rehabilitated or restored where this is beneficial to the ecosystem

The LSC and the Binational Program are working cooperatively to rehabilitate degraded fish populations, fish communities, and aquatic habitats in the lake. The Walleye Subcommittee is developing quantifiable population and habitat objectives. The Subcommittee also redrafted the existing fish-community objective that related to walleyes so that teams drafting sections of this plan and other plans could share the same vision for the future. The Walleye Subcommittee recommends adopting the following fish-community objective for Lake Superior walleye:

> *Lake Superior will be managed to maintain, enhance, and rehabilitate habitat for, and self-sustaining populations of, walleye in their historic range. Management strategies will be implemented to attempt to reach objectives specific to individual walleye populations and habitats.*

Objectives for rehabilitation of walleye populations are to:

- Increase the relative abundance of juvenile walleye
- Increase the abundance of spawning walleye in the:
  - Pigeon River in Minnesota and Ontario
  - Bad River in Wisconsin
  - St. Marys River in Ontario and Michigan
  - Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and Thunder Bay in Ontario

Assessment of progress toward achievement of walleye-population rehabilitation objectives will be measured by the:

- Relative abundance of age-0 and age-1 walleyes taken in electrofishing surveys in the St. Marys River and Lower Tahquamenon River

- Absolute abundance of spawners in the:

  – Pigeon River in Minnesota and Ontario

  – Bad River in Wisconsin

  – St. Marys River in Ontario and Michigan

  – Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and Thunder Bay in Ontario

Objectives for rehabilitation of walleye habitats are to:

- Create or maintain spawning and nursery habitats in the:

  – St. Marys River in Ontario and Michigan

  – Tahquamenon River, Ontonagon River, and Huron Bay watershed in Michigan

- Enhance fish passage in the Ontonagon River

- Improve water quality

- Reduce contaminant concentrations in walleye

- Reduce sedimentation in the Huron Bay watershed and Ontonagon and St. Marys Rivers

- Assess progress toward rehabilitation of walleye habitat

ISSUES AND STRATEGIES

Walleye populations have declined in seven areas of Lake Superior as the result of overharvesting (Schneider and Leach 1977; Colby and Nepszy 1981) and habitat loss or degradation (Ryder 1968). Strategies to rehabilitate walleye populations may include:

- Stocking eggs, fry, fingerlings, and/or adults
- Controlling fish harvest to maintain or reduce total annual mortality
- Protecting and maintaining remaining habitat

POPULATION ISSUES AND STRATEGIES

Walleye populations in Whitefish Bay (includes the upper St. Marys River, Goulais Bay, and Batchawana Bay), Nipigon Bay, Black Bay, and Thunder Bay were once the largest populations in the Ontario waters of Lake Superior (Schram et al. 1991). However, all of these populations have declined—especially during the 1950s and 1960s. Overharvesting likely contributed to population declines in Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and the Bad River (MacCallum and Selgeby 1987; Kelso et al. 1996; G. Rose, Ontario Ministry of Natural Resources, 1235 Queen St. E., Sault Ste. Marie, ON, P6A 2E5, pers. commun.; E. Soulier, Bad River Natural Resources Director, P.O. Box 39, Odanah, WI, 54861, pers. commun.).

One population not overharvested is that of western Lake Superior that spawns mainly in the St. Louis River. Total annual mortality of mature walleyes in this population was estimated at 42% during 1979-82—a time when the population supported both a sport and commercial harvest and contained fish older than age 20 (Schram et al. 1992). Because population size and structure were maintained in the St. Louis River when total annual mortality was 42%, the Walleye Subcommittee recommends that the upper limit on mortality should be kept close to this figure and not exceed 45% during the rehabilitation of other Lake Superior walleye populations. Controlling fishing pressure is important for walleye rehabilitation in the St. Marys River, Lower Tahquamenon River, Pigeon River, Bad River, Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and Thunder Bay.

Rehabilitation of some populations may require stocking to either subsidize natural recruitment or replace natural recruitment until populations are self-sustaining at rehabilitation objectives. Fingerling stocking should be considered in the:

- St. Marys River at a rate of 100,000 annually
- Lower Tahquamenon River at a rate of 30,000 biannually
- Pigeon River at a rate of 8,000 annually
- Bad River at a rate of 4,000 annually
- Goulais Bay at a rate of 25-50/ha annually
- Batchawana Bay at a rate of 25-50/ha annually

The stocking rates for the St. Marys, Tahquamenon, Pigeon, and Bad Rivers were established by consensus of state and tribal managers. The rates for Goulais and Batchawana Bays are recommended for Ontario stocking programs (Kerr et al. 1996). Walleye fingerlings and adults should be either progeny of fish from the area undergoing rehabilitation or fish from adjacent or other Lake Superior populations (Billington and Hoff 1996). All walleyes should be permanently marked prior to stocking to evaluate contributions of stocked fish. Stocking practices should be evaluated again when population rehabilitation or management targets are reached.

Rehabilitation targets for walleye populations may include:

- Seven age-0 and age-1 walleyes/electrofishing hour/index station and eight age-classes in the St. Marys River (Michigan) and Tahquamenon River assessment catches

- A spawning population of 1,000 in the Pigeon River

- A spawning population of 7,000 in the Bad River

- A spawning population of 1,000 in the St. Marys River (Ontario)

- A spawning population of 500 in Goulais Bay

- A spawning population of 500-1,000 in Batchawana Bay

- A spawning population of 5,000 in Thunder Bay

- A population of either 22,000 adult fish or 41,000 fish over 356-mm total length in Nipigon Bay

- Catches in index gillnets of 150 kg/km in Black Bay

No historic population data exist for the walleye population of the Bad River so population estimates from the nearby Kakagon River were used to formulate the rehabilitation target. Annual estimates of adult population sizes in the Kakagon River during 1988-90 averaged approximately 7,000 (F. Stone, U.S. Fish and Wildlife Service, 2800 Lake Shore Drive E., Ashland, WI, 54806, pers. commun.)—this number will be used as the target for the Bad River population. Population targets for the St. Marys River (Ontario), Goulais Bay, and Batchawana Bay were based on genetic principles and guidelines (Nelson and Soule 1987; Billington 1996; Billington and Hoff 1996). Targets for Nipigon Bay, Black Bay, and Thunder Bay were based on historical measurements of either absolute or relative abundances (Ryder 1968; Geiling et al. 1996; J. Black, Ontario Ministry of Natural Resources, Lake Superior Management Unit, 435 James St. S., Suite 221, Thunder Bay, ON, P7E 6E3, unpubl. data).

HABITAT ISSUES AND STRATEGIES

Lake Superior walleye habitats have been degraded by:

- Reduction or elimination of fish passage in the Ontonagon River
- Reduction in water quality caused by:
  - Sedimentation
  - Point-source discharge
  - Non-point-source discharge
  - Atmospheric deposition of contaminants into the lake
- Loss of spawning and nursery habitats in the:
  - Ontonagon, Tahquamenon, and St. Marys Rivers
  - Huron Bay watershed
  - Nipigon and Thunder Bays

Lake Superior Strategies

Strategies to rehabilitate Lake Superior walleye habitats are:

- Enhance fish passage at the Victoria Dam on the Ontonagon River and at other dams, where required
- Improve land- and water-use practices in the watershed
- Reduce sedimentation by 50% in the St. Marys River, the Tahquamenon River, and the Huron Bay watershed
- Eliminate point-source discharges of persistent toxic chemicals into the lake
- Create or rehabilitate spawning and nursery habitats in the St. Marys River, Tahquamenon River, Ontonagon River, and Huron Bay Watershed—Thunder Bay and an Ontario tributary of the St. Marys River have already benefited from habitat improvement

St. Marys and Tahquamenon Rivers Strategies

Rehabilitation strategies developed for walleye habitats in the upper St. Marys and lower Tahquamenon Rivers include improvement of land use, water use, and habitat-management practices. Habitat targets were developed based on known habitat preferences and losses or assumed needs for populations. Gravel and rubble spawning habitat provides the highest rate of walleye embryo survival (Johnson 1961). The spawning habitat target was developed assuming 2,500 female walleyes spawn every year and each female requires 20 m^2 of spawning substrate. Sparse, submerged aquatic-macrophyte beds in sheltered areas provide nursery habitat for juvenile walleyes (Ryder 1977; Colby et al. 1979). The nursery habitat target was developed assuming that each of 2,500 females produces 100,000 larvae—each of which requires 2 m^2 of macrophyte habitat.

Walleye habitat targets include:

- Spawning and nursery habitats in the upper St. Marys and lower Tahquamenon Rivers should be enhanced to a minimum of 5 ha coarse gravel and rubble spawning habitat and at least 20 ha of macrophyte habitat; optimally, 15 ha of spawning habitat distributed among several sites in each river is the target for rehabilitation

- Sedimentation resulting from lake and river dredging, recreational- and commercial-vessel operation, eroding banks and shorelines, agricultural runoff, residential and commercial development, and timber harvest should be reduced by 50%; fishery- and natural-resource managers should cooperate with businesses and federal, tribal, state, and local governments to reduce sources of sedimentation

- Bank stabilization, improved zoning, riparian zones, and stream/river corridors should be developed; private landowners—including timber companies and homeowners—should be encouraged to protect riparian and lotic habitats

- Riparian zones should be established 10 km above each known spawning site in the Tahquamenon and Waishkey Rivers; logging, bank development, and road construction should be discouraged in those areas

- The commercial shipping industry, U.S. Army Corps of Engineers, and U.S. Coast Guard should be encouraged to use practices that do not degrade aquatic habitats

Ontonagon River and Huron Bay Strategies

Rehabilitation strategies identified for the Ontonagon River and the Huron Bay watershed (Silver, Ravine, and Slate Rivers) are to improve water- and land-use practices. Walleye habitat in the Ontonagon River and the Huron Bay watershed should be maintained and restored where degraded.

Specific strategies to maintain or rehabilitate walleye habitats in the Ontonagon River and Huron Bay Watershed are:

- The Victoria Dam on the Ontonagon River should be required to maintain run-of-the-river flows and to provide a suitable walleye passageway while limiting passage of sea lampreys

- Land-use practices that contribute to sedimentation along the Ontonagon River and in the Huron Bay watershed should be modified to reduce sedimentation by 50%

- Spawning and nursery areas in the Ontonagon River and Huron Bay watershed should be maintained or enhanced

- Agencies and businesses involved with timber harvest, road and highway construction, and municipal and residential development should implement and evaluate riparian and wetland-protection practices

Bad River Strategies

Poor forestry and agricultural practices have contributed to reduced water quality in the Bad River. Strategies to rehabilitate water quality for walleyes are to:

- Use forestry best management practices recommended statewide by the Wisconsin Department of Natural Resources

- Encourage better management of livestock and associated wastes in the watershed

- Protect wetlands in the watershed

Other River Strategies

Concentrations of persistent, toxic chemicals in walleyes from the St. Louis River, Kakagon River, Bad River, Goulais Bay, Batchawana Bay, and Nipigon Bay are above consumption advisories. Rehabilitating water and sediment quality for walleye habitat rehabilitation in Lake Superior will be achieved through:

- Implementation of programs and measures to control St. Louis River pollution sources and remediation of environmental problems by incorporating the Remedial Action Plan into Minnesota and Wisconsin water management plans

- Zero point-source discharge of persistent, toxic chemicals into the lake following strategies in the Binational Program (Lake Superior Work Group, 1998)

ROUTINE ASSESSMENT

Five types of assessments are recommended:

1. Conduct standardized assessments to collect data on growth and mortality for all populations in need of rehabilitation; total annual mortality rates should be computed from the right-hand limb of age-frequency catch curves for spawning-ground collections taken in trapnets or by electrofishing; mortality will be computed from age-classes that are fully recruited to the gear (Ricker 1975)

2. Conduct mark-recapture studies to estimate the population size of walleyes in the Pigeon River, Bad River, St. Marys River (Ontario), Goulais Bay, Batchawana Bay, Nipigon Bay, and Thunder Bay

3. Conduct assessments to index relative abundances of walleyes in the St. Marys River (Michigan), Lower Tahquamenon River, and Black Bay

4. Inventory spawning and nursery habitats in the St. Marys River, Lower Tahquamenon River, Ontonagon River, and the Huron Bay watershed

5. Conduct angler and commercial surveys to determine exploitation

RESEARCH AND ASSESSMENT NEEDS

The following research studies and assessments are needed to aid in or evaluate progress towards rehabilitation of walleye populations and habitats in Lake Superior:

- Determine habitat requirements for early life stages of walleye in Lake Superior and its tributaries

- Determine effects of dams on walleye populations and habitats

- Assess the effectiveness of stocking walleyes at all Lake Superior locations

- Determine stock-recruit relationships for those Lake Superior walleye populations not substantially affected by spawning- and nursery-habitat degradation; revise population rehabilitation objectives, as necessary, based on the findings of such relationships

- Determine relationships between lotic- and lentic-habitat characteristics and Lake Superior walleye population sizes and structures; revise habitat-rehabilitation objectives, as necessary, based on the findings of such relationships

- Determine the genetic stock structure of walleyes in Lake Superior; determine the surplus production and seasonal distributions and habitats for each important stock so that harvest targeted at one stock does not create risks to another stock inhabiting the same area

- Determine if fish assemblages in rivers, estuaries, bays, and harbors are functional fish communities and if walleyes are important in structuring fish communities; develop models that accurately predict the effects of changes in walleye populations on associated fish communities

- Assess food habits of walleye for inclusion in bioenergetic models

REPORTING

Data and technical information from research and assessments and progress toward rehabilitation of walleye populations and habitats should be reported to the LSC at least every five years. Submissions should be timed so they can be incorporated into the State of Lake Superior Report.

Reports should contain:

- Estimates of relative or absolute abundances of walleye for each population
- Estimates of total annual mortality rates for each population
- Stocking rates and evaluations of recruitment for stocked fish
- Records of habitat improvements
- Progress toward population- and habitat-rehabilitation objectives

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The membership of the Walleye Subcommittee is Michael H. Hoff (Chairperson, U.S. Geological Survey), Michael Gallinat (Red Cliff Fisheries Department), Kenneth Gebhardt (Bay Mills Indian Community), Steven A. Geving (Minnesota Department of Natural Resources), Susan Greenwood (Ontario Ministry of Natural Resources), John R. M. Kelso (Department of Fisheries and Oceans), Joe Dan Rose (Bad River Band of Lake Superior Chippewas), Henry Quinlan (U.S. Fish and Wildlife Service), Stephen Schram (Wisconsin Department of Natural Resources), William Mattes (Great Lakes Indian Fish and Wildlife Commission), Steve Scott (Michigan Department of Natural Resources), and John Weisser (U.S. Fish and Wildlife Service). This is Contribution 1194 of the U.S. Geological Survey, Great Lakes Science Center.

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February 1993	What's next? the prediction and management of exotic species in the Great Lakes (report of the 1991 workshop). E.L. Mills, J.H. Leach, C.L. Secor, and J.T. Carlton. 22 p.
August 1993	A survey of fish-community and habitat goals/objectives/targets and status in Great Lakes areas of concern. J.H. Hartig. 95 p.
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April 1996	A lake trout restoration plan for Lake Superior. M.J. Hansen [ED.]. 34 p.
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