A REHABILITATION PLAN FOR WALLEYE POPULATIONS AND HABITATS IN LAKE SUPERIOR

Prepared for the Great Lakes Fishery Commission's
Lake Superior Committee
and
Lake Superior Technical Committee

by the
Walleye Subcommittee

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TABLE OF CONTENTS

Lake Superior Walleye Population and Habitat Rehabilitation Plan

ABSTRACT. Walleye (*Stizostedion vitreum*) was important in regional fisheries in large bays, estuaries, and rivers of Lake Superior, and was important in the fish communities of those systems until overharvest, habitat degradation, poor watershed land use practices, river damming, and pollution caused declines in populations and habitats during the late 1800s and early 1900s. A lakewide goal to aid in recovery of depressed populations of walleye should be to maintain, enhance, and rehabilitate habitat for walleye, and to promote self-sustaining populations in areas where walleyes historically lived. Population objectives to support the goal are to increase abundance of juvenile and adult walleyes in selected areas. Habitat objectives to 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 increases in spawning and nursery habitats, resolution of fish passage issues, reduction in sediments in rivers, and reductions in contaminant levels in walleyes. Stocking of various life stages of walleye should be considered to rehabilitate some degraded populations. Total annual mortality of walleye populations should be less than 45% to allow populations to increase or be maintained at target levels of abundance. Routine assessments should focus on gathering data necessary to evaluate abundance and mortality, and to inventory spawning and nursery habitats. Research should be conducted to understand the specific habitat requirements for Lake Superior walleye populations, and habitat-abundance relationships in populations and the lake.

INTRODUCTION

The walleye (*Stizostedion vitreum*) was important in regional fisheries (Hoff 1996) and communities (e.g., Hoff and Bronte 1999) in large bays, estuaries, and rivers of the lake. However, overharvest, habitat degradation, poor watershed land use practices, river damming, and pollution caused declines in walleye populations and degradation of their habitats in the first half of this century (Hoff 1996). To aid managing the Great Lakes as an ecosystem, A Joint Strategic Plan for Management of Great Lakes Fisheries (Great Lakes Fishery Commission 1997) was developed, which required development of fish community objectives to provide the framework to rehabilitate degraded or lost fishery resources. One of the objectives developed for Lake Superior in response to the plan was to *"Manage exploitation of nondepleted stocks to maintain a stable, self-sustaining status for ... walleye,"* while another objective was to *"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"* (Busiahn 1990).

The Lake Superior Technical Committee (LSTC) realized the need to develop a plan to rehabilitate walleye populations and habitats in the lake, but also realized that too little data were readily available to develop that plan. Therefore, the LSTC created the Walleye Subcommittee to report on the status of walleye populations in the lake and then 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, which were two of the largest in Lake Superior (Ryder 1968; Schneider and Leach 1977; Kelso et al. 1996), had been nearly extirpated.

Insufficient historic data for some populations makes it impossible to develop rehabilitation programs that are scientifically based. Consequently, rehabilitation programs for some walleye populations and habitats have followed recommendations of minimum effective populations size (Billington 1996) or goals set by fishery managers. The following historical account of Goode (1884) is valuable because it describes rare information on relative abundances of walleyes in fisheries across U.S. 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 or management agencies have prepared management plans that describe intentions 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 aid interjurisdictional coordination of 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 of their implementation are evaluated and reported.

MANAGEMENT AREAS

The appropriate spatial units for rehabilitation of walleye populations and habitats are either 1) individual populations or habitats, or 2) political jurisdictions. This plan describes important issues, objectives, and strategies regarding rehabilitation on individual population or habitat bases. The walleye populations and habitats selected for rehabilitation (Figure 1) can be combined into jurisdictions for management on that scale.

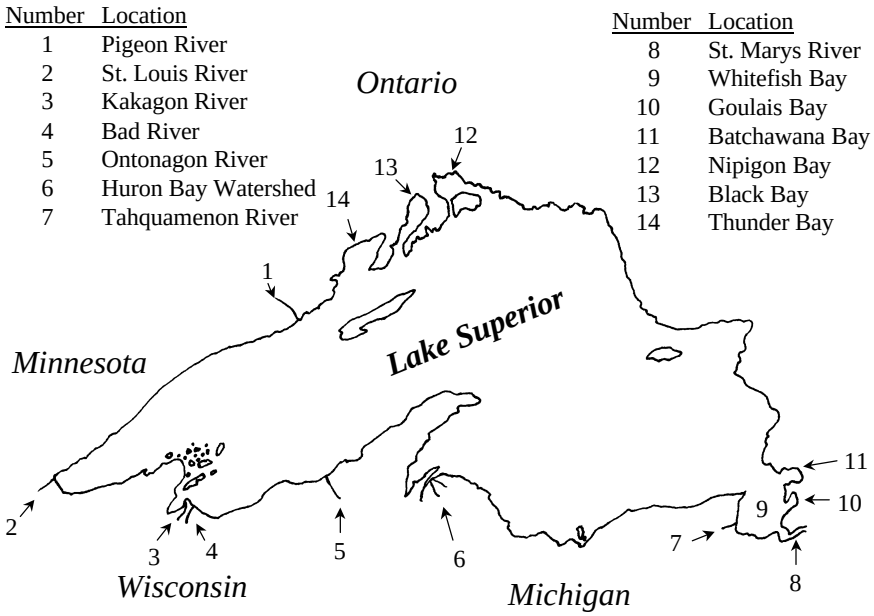

Figure 1. Locations of Lake Superior walleye populations and habitats in need of rehabilitation.

OBJECTIVES FOR REHABILITATION

Walleye populations and habitats selected for rehabilitation met three criteria: 1) the population existed historically; 2) the population declined; and 3) and management agencies with jurisdiction were committed to rehabilitation. Walleye habitats were selected for rehabilitation if local management agencies documented or agreed that degradation or loss occurred in that watershed.

The walleye objective outlined in "Fish Community Objectives for Lake Superior" (Busiahn 1990) was to manage exploitation of non-depleted stocks to maintain stable self-sustaining status, and to re-establish depleted stocks. The Lake Superior Committee wished to develop more quantifiable and specific rehabilitation goals for walleye populations and habitats that were more compatible with Lake Superior Binational Program objectives. The Lake Superior Committee, Lake Superior Technical Committee, and the Walleye Subcommittee members operate under the auspices of the Great Lakes Fishery Commission and serve as linkages to the Lake Superior Binational Program. The Lake Superior Binational Program aquatic communities objective recommended that the lake should sustain diverse, healthy, reproducing and self-regulating aquatic communities closely representative of historical conditions (Lake Superior Work Group undated). The Lake Superior Binational Program ecosystem objectives further recommended that: 1) native aquatic species associations should be recognized as key elements of a healthy Lake Superior ecosystem; and 2) degraded habitat features should be rehabilitated or restored where this is beneficial to the ecosystem.

The Lake Superior Committee and the Binational Program are working cooperatively to rehabilitate degraded fish populations, communities, and aquatic habitats in the lake. The Walleye Subcommittee was formed by the Lake Superior Committee and the Lake Superior Technical Committee to develop quantifiable population and habitat objectives. The Walleye Subcommittee redrafted the existing fish community objective that related to walleye so that teams drafting sections of this plan and others share the same vision for the future. The Walleye Subcommittee suggests adopting the following fish community objective for Lake Superior walleye.

> *The Lake Superior fish community will be managed to maintain, enhance, and rehabilitate habitat for, self-sustaining populations of walleye in areas where the species historically maintained populations. Management strategies will be implemented to attempt to reach objectives specific to individual walleye populations and habitats.*

Objectives for rehabilitation of walleye populations are:

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

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

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

Absolute abundance of spawners in the Pigeon River, Minnesota and Ontario; Bad River, Wisconsin; St. Marys River, Ontario and Michigan; Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and Thunder Bay, Ontario.

Objectives for rehabilitation of walleye habitats are to:

Create or maintain spawning and nursery habitats in the St. Marys River, Ontario and Michigan; and Tahquamenon River, Ontonagon River, and Huron Bay Watershed, Michigan
Enhance fish passage
Increase water quality
Reduce contaminant concentrations in walleyes
Reduce sedimentation in rivers.

Assessment of progress toward rehabilitation of walleye habitat objectives will be measured by:

Abundances of spawning and nursery habitats
Enhancement of fish passage
Increases in water quality
Reduction in persistent contaminants in walleye fillets
Reductions in the amount of sedimentation in rivers.

ISSUES AND STRATEGIES

Walleye populations declined in seven areas of Lake Superior as the result of:

Overharvest (Schneider and Leach 1977; Colby and Nepszy 1981)
Habitat loss or degradation (Ryder 1968).

Strategies to rehabilitate walleye populations may include:

Stock eggs, fry, fingerlings, and/or adults
Control fish harvest to maintain or reduce total annual mortality
Protect and maintain remaining habitat.

Population Issues and Strategies

Walleye populations in Whitefish Bay (includes the upper St. Marys River, and Goulais and Batchawana bays), 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 those populations have declined. Overharvest likely contributed to population declines in Goulais Bay, Batchawana Bay, Nipigon Bay, Black Bay, and the Bad River (Rose 1984; MacCallum and Selgeby 1987; Kelso et al. 1996; Erv Soulier, Bad River Natural Resources Director, P.O. Box 39, Odanah, WI 54861, personal communication).

One population that has not been overharvested is the Western Lake Superior population that mainly spawns in the St. Louis River. Total annual mortality of mature walleyes in that population was estimated at 42% during 1979-1982, when the population supported sport and commercial harvest and contained fish over age 20 (Schram et al. 1992). Because population size and structure were maintained in the St. Louis River when total annual mortality was 42%, mortality should not exceed 45% during rehabilitation of other Lake Superior walleye

populations. Controlling exploitation is important to 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:

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.

Stocking rates for the St. Marys River, Tahquamenon River, Pigeon River, and Bad River were established by consensus of state and tribal managers, and the rate for Goulais Bay and Batchawana Bay is 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 re-evaluated when population rehabilitation or management targets are reached. Rehabilitation targets for walleye populations may include:

7 age-0 and age-1 walleyes/electrofishing hour/index station, and 8 ages classes are represented in assessment catches in the St. Marys River (Michigan) and Tahquamenon River
The spawning population reaches 1,000 in the Pigeon River
The spawning population reaches 7,000 in the Bad River
The spawning population reaches 1,000 in the St. Marys River (Ontario)
The spawning population reaches 500 in Goulais Bay
The spawning population reaches 500-1,000 in Batchawana Bay
The spawning population reaches 5,000 fish in Thunder Bay
The population reaches either 22,000 adult fish or 41,000 fish over 356 mm in Nipigon Bay
Catches in index gill nets reach 150 kg/km in Black Bay.

No historic population data exist on which to base a goal for the walleye population of the Bad River, so population estimates from the nearby Kakagon River were used to formulate the target for the Bad River. Annual estimates of adult population sizes in the Kakagon River during 1998-1990 averaged approximately 7,000 (Stone and Slade 1992), which 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), whereas targets for Nipigon Bay, Black Bay, and Thunder Bay were based on historical measurements of 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, and atmospheric deposition of contaminants into the lake
- Degradation of spawning and nursery habitats in six areas.

Strategies to rehabilitate Lake Superior walleye habitats are to:

- Enhance fish passage past 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, Tahquamenon River, and the Huron Bay Watershed
- Eliminate point source discharge 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 (two areas have already benefitted from habitat improvement).

Rehabilitation strategies developed for walleye habitats in the upper St. Marys and lower Tahquamenon rivers include improvement of land use, water use, and habitat improvement practices. Habitat targets were developed based on known habitat preferences and known 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 walleye spawn every year, and each female requires 20 m^2 of spawning substrate. Sparse submerged aquatic macrophytes in sheltered areas provides nursery habitat for juvenile walleyes (Ryder 1977; Colby et al. 1979). The nursery habitat target was developed assuming 2,500 females each produce 100,000 larvae, and each requires 2 m^2 of macrophyte habitat.

- 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, which is distributed among several sites in each river, is the target for habitat rehabilitation.
- Sedimentation, resulting from lake and river dredging, recreational and commercial vessel navigation, eroding banks and shorelines, agricultural runoff, 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, and 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.

Rehabilitation strategies identified for the Ontonagon River and Huron Bay Watershed (Silver, Ravine, and Slate rivers) are to improve water and land use practices. Walleye habitats in the Ontonagon River and 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 following:

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 lamprey.

Land use practices that contribute to sedimentation along the Ontonagon River and in the Huron Bay Watershed should be reduced or restricted to reduce sedimentation by 50%.

Spawning and nursery areas in the Ontonagon River and Huron Bay Watershed should be maintained and/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.

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

Employ forestry Best Management Practices recommended statewide by the Wisconsin Department of Natural Resources

Employ better management of livestock and associated wastes in the watershed

Protect wetlands in the watershed.

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 remediate environmental problems by incorporating the RAP 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 undated).

ROUTINE ASSESSMENT

Four types of assessments are recommended:

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

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

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

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

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 toward rehabilitation of walleye populations and habitats in Lake Superior:

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

Determine effects of dams on walleye populations and habitats.

Assess the effectiveness of stocking walleyes in all Lake Superior locations.

Determine stock-recruit relationships for Lake Superior walleye populations not substantially affected by spawning and nursery habitat degradation. Revise population rehabilitation objectives as necessary based on the results of this research.

Determine relationships of lotic and lentic habitat characteristics to Lake Superior walleye population sizes and structures. Revise habitat rehabilitation objectives as necessary based on the results of this research.

Determine genetic or environmental stock structure of walleyes in Lake Superior.

Determine the surplus production and seasonal distributions and habitats used by each important stock so that harvest of each important stock is managed without risk to other stocks.

Determine the existence and structures of Lake Superior fish communities, and the relationships of walleyes to those communities. Develop models that accurately determine effects of changes in walleye populations and the other components of Lake Superior fish communities.

Assess food habits of walleye for inclusion in bioenergetic modeling.

REPORTING

Data and technical information from research and assessments, and progress toward rehabilitation of walleye populations and habitats should be reported to the Lake Superior Committee at least every five years. Reports submissions should be timed so that 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 stocked fish recruitment

Habitat improvements that have occurred

Progress toward population and habitat rehabilitation objectives

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