ST. MARYS RIVER

FISHERIES ASSESSMENT PLAN

ST. MARYS RIVER FISHERIES TASK GROUP
LAKE HURON TECHNICAL COMMITTEE
GREAT LAKES FISHERY COMMISSION

March, 2002

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FISHERIES ASSESSMENT PLAN

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ABSTRACT

The St. Marys River supports an intensive recreational fishery, equivalent to 36% of the sport fishery in all the Michigan waters of Lake Huron, as well as tribal subsistence and commercial fisheries. Past investigations have suggested that native species such as walleye, northern pike, and yellow perch exhibit high total annual mortality while the status of other fish species is largely unknown or dated. Stakeholders and agencies responsible for the management of the fishery have expressed concern about the sustainability of fish populations and the capability of the river to support them. To date, research, assessment, and management initiatives for the river' s fisheries resources have been largely fragmented and uncoordinated. Most initiatives have been in response to a crisis in the fishery or have occurred only intermittently. The lack of a regular, coordinated effort to assess and manage the fishery stems from the jurisdictional fragmentation among agencies on both sides of the international border. The St. Marys River Fisheries Task Group (SMRFTG) was established by the Lake Huron Committee (LHC) under the Lake Huron Technical Committee (LHTC) in 1997 to "design and recommend a fisheries assessment and review program which will enhance our understanding of the St. Marys River fish community and associated habitats and the factors which may impact those populations". Additional charges from the LHC included consultation with stakeholders, facilitating interagency cooperation and recommending prioritized assessment and research projects to deal with current fishery concerns in the St. Marys River. This plan provides a standardized approach for regular assessment of the river' s fishery and aquatic resources. Included are approaches for fish community assessment, fish harvest estimates and reporting, lower trophic level monitoring, and habitat mapping and data collection. The plan is intended to serve as a mutual and coordinated approach to assessment for agencies and academia. Findings resulting from such surveys will enable a coordinated management strategy towards common objectives through the Great Lakes Fishery Commission' s Lake Huron Committee.

PREFACE

The St. Marys River Fisheries Task Group (SMRFTG, see Appendix 1 for a summary of acronyms used in this plan) was established by the Lake Huron Committee (LHC) under the Lake Huron Technical Committee (LHTC) in 1997. The Task Group was charged to "*design and recommend a fisheries assessment and review program which will enhance our understanding of the St. Marys River fish community and associated habitats and the factors which may impact those populations*". Additional charges from the LHC include consultation with stakeholders, facilitation of interagency cooperation, and the recommendation of prioritized assessment and research projects to deal with current fishery concerns in the St. Marys River.

Public stakeholders, including representatives from local sport fishing clubs, environmental organizations, municipalities, Native American Tribes, and First Nations were invited to meet with the STMRFTG on two occasions. These meetings were intended as an opportunity for local stakeholders to meet representatives from fishery management agencies (FMAs) and to identify and discuss issues and concerns for St. Marys River fisheries (Greenwood et al. 2002).

Stakeholders expressed concerns about negative impacts by exotic aquatic species and cormorants, the quality and safety of food fishes, declines in aquatic insects, sport, commercial and subsistence harvest levels, inconsistent angling regulations and law enforcement, stocking, water quality, user conflicts, and inadequate funding for fisheries management. SMRFTG members, on behalf of their agencies, undertook a similar exercise to identify issues and concerns. Their list included the need to ensure healthy, sustainable fisheries and fish communities, maintenance of effective sea lamprey control, productive sport fisheries, negative impacts of exotic species and aquatic habitat maintenance and protection (Greenwood et al. 2002).

The Task Group recognized that the outcome of this process would be identification of biological and resource use issues requiring assessment action and/or management action. The SMRFTG envisioned that part of its responsibility was to differentiate between assessment and management issues and report on concerns that would benefit from an assessment plan that supported future fisheries management decision making. Historical and current fishery assessment activities were evaluated by the SMRFTG to determine if existing information was sufficient to address the identified concerns.

This assessment plan is a result of the cooperative process among government agencies, and stakeholders, and is intended to serve as a guide to facilitate coordinated assessment and research activities in the St. Marys River.

INTRODUCTION

Vision Statement

It was necessary for the SMRFTG to develop a vision statement for the St. Marys River that encompassed the diversity of interest and multiple use desires of all stakeholders. It was also important to identify fishery, habitat, and fish population goals that were common to agency representatives and stakeholders. The vision statement for the St. Marys River is that:

> *St. Marys River fishery resources should be capable of supporting sustainable harvest opportunities for diverse fisheries including recreational, subsistence, and limited commercial activities. Habitats within the river needs to be maintained and enhanced to maximize fish population growth and abundance.*

The SMRFTG also recognizes that, despite the above vision statement, more specific fish community objectives (FCOs) are lacking for the St. Marys River. The SMRFTG recommends the development of river specific FCOs to better facilitate establishing management direction.

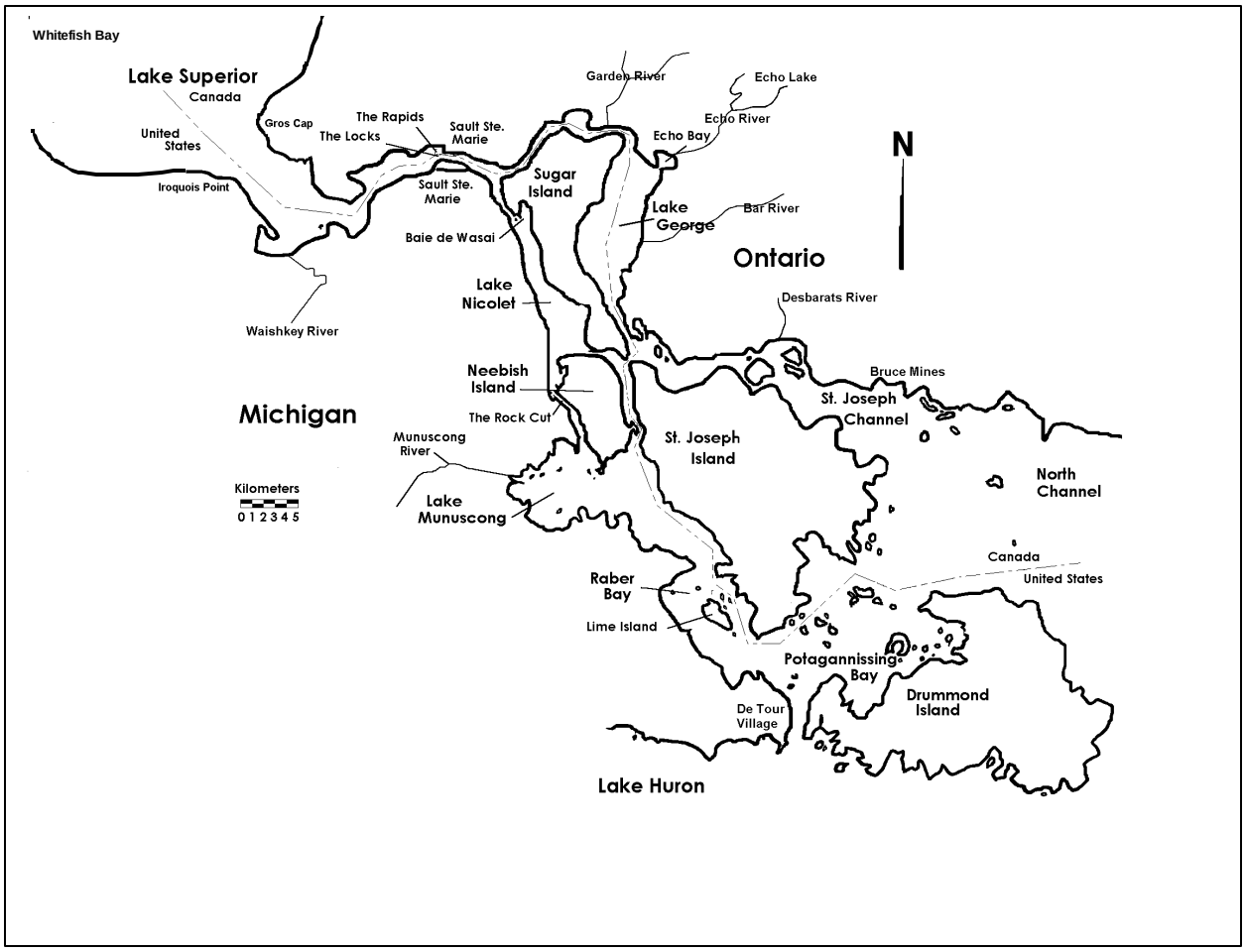
Historical and Current Perspectives

History of the River and Fishery. - At the end of the Wisconsin glacial period 11,000- 10,000 years before present (YBP), the St. Marys River was a strait connecting Lake Superior to Lake Huron (Duffy et al. 1987). At that time, the fish community would likely have reflected the colonization by coldwater fishes such as salmonines (e.g. lake trout, brook trout; see appendix 2 for a complete listing of common and scientific names of fishes mentioned in this plan) and coregonines (e.g. lake whitefish, ciscoes, chubs) of the newly formed upper Great Lakes. The St. Marys River was created when post glacial crustal rebound as recently as 3,000 (YBP) uplifted rock ledges above Lake Huron' s level, creating the St. Marys rapids (Duffy et al. 1987). This changed the physical habitat considerably. Some fish could no longer migrate freely between the lakes and productivity increased in shallow water habitats.

The St. Marys Rapids, originally called Bawating meaning "water pitching over rock", was the site of an important seasonal whitefish fishery for centuries before European contact. Thousands of Native peoples from the Great Lakes basin and beyond would arrive in late spring to harvest whitefish over the summer. The early fishery was likely controlled by limiting the numbers of participants into the fishery based on their relationships with local Native harvesters.

European settlement brought significant changes to the St. Marys River. By the mid-1800s, non-Native commercial fisheries were established by the fur-trading companies (Edsall and Gannon 1993). By the late 1800s, sport fisheries were well established and concerns for their sustainability prompted restrictions and closures on the commercial fishery. In the mid-1850s the first of several locks was completed to allow vessels past the rapids. Extensive dredging and re-aligning of channels also occurred to aid vessel navigation. Shoreline developments such as shipyards, steel production, a major tannery, and docking facilities removed or degraded productive fish habitat and added industrial pollution to the river. Hydroelectric stations and the control of water flows also affected fish spawning and nursery habitat as well as aquatic food production.

Figure 1: St. Marys River, connecting channel between Lake Superior and Lake Huron.



The clearing of land for agriculture and forestry activities in the immediate watershed and transport of timber also changed and degraded fish habitat.

Today, the St. Marys River is 112 km in length, originating from Whitefish Bay in Lake Superior and emptying into Lake Huron at De Tour Village, Michigan and Bruce Mines, Ontario (Figure 1). Over its course the river falls 6.7 m, with 6.1 m of this drop occurring in the rapids. The river has a drainage area of 21,000 km^2, and is the only outlet from Lake Superior. The upper river extends 22.5 km from the origin at Whitefish Bay to the rapids, which itself is 1.2 km long. Four large islands, numerous smaller ones and a series of interconnected channels and bays characterize the lower river (Duffy et al. 1987).

Today's Fishery and Current Management. - The St. Marys River provides a large and diverse fishery. The sport fishing pressure alone for the period of May through October 1999 was 36% of the total pressure for the Michigan waters of Lake Huron (MDNR unpublished data). A large sport fishery for yellow perch, lake herring, lake whitefish, walleye, and salmonines occurs throughout the year and is regulated by MDNR on the U.S. side and OMNR on the Canadian side. Subsistence fisheries, regulated by the CORA tribes (U.S.) and Garden River First Nation (Canada), utilize both gillnet and angling gear. Native, tribal and non-native commercial fishing for whitefish occurs in the headwaters of the St. Marys River in Whitefish Bay. An OMNR regulated commercial gillnet fishery operates in the western end of the North Channel which reaches into Potagannissing Bay along the Seine Islands. Fisheries management in the river includes regulations on harvest (seasons, limits, gear), fisheries assessment, sea lamprey control, stocking, habitat protection and enhancement, and research by state, provincial, tribal and federal agencies and academic institutions. Sport fishing regulations are set in Ontario by the OMNR, and in Michigan by the MDNR. These regulations often differ in the season dates, length limits and permitted techniques.

Past Assessment and Management Activities

Historical Assessment and Research Activities. - The St. Marys River has been the subject of numerous fishery assessment and research projects for many years. Unfortunately, these studies have not provided fishery managers with the consistent information necessary to effectively manage the river' s fishery, habitat, and water resources. Few studies have been designed to collect long-term data required to evaluate fish populations, habitat, and water quality. Most studies have either been of short duration, widely separated in time, species specific, or conducted without coordination among managing agencies and governments. The reasons for this are diverse –from jurisdictional fragmentation to inconsistent priority setting by participating agencies. The SMRFTG maintains and regularly updates a table of historical and current assessment activities and fish stocking conducted by all agencies, governments, and universities in the St. Marys River. This information is available upon request from the SMRFTG.

Long-term Fishery Assessment Activities. - The MDNR and cooperating agencies and governments conducted standardized variable mesh gillnet assessments to evaluate fish abundance and population characteristics in the St. Marys River in 1975, 1979, 1987, and 1995 (Schorfhaar 1975; Miller 1981; Grimm 1989; Fielder and Waybrant 1998). These assessments described existing fish population

characteristics and made some analysis of trends but were limited in value due to the time span between studies.

The Inter-Tribal Fisheries and Assessment Program (ITFAP) and Bay Mills Indian Community (BMIC) have conducted annual assessments to evaluate abundance and population characteristics of commercial, sport, and forage fish species in the upper St. Marys River and Waishkey Bay since 1991. These studies, however, omitted large sections of the middle and lower river. Lake Superior State University Aquatic Research Lab (LSSU-ARL) began collecting information pertaining to population dynamics, movement, and angler harvest of Pacific and Atlantic salmonines as well as abundance of other fish species in the lower St. Marys River in 1989. These projects have been largely species specific and omitting certain portions of the fish community.

Short-Term Fishery Assessment and Monitoring Activities. – Many fishery assessment and research projects in the St. Marys River have historically been short-term studies designed to address critical fishery issues or to obtain information for management. Many projects have been conducted to specifically access impacts of shipping and navigation season. Most projects were conducted for less than three years and were not designed to evaluate long-term fish population, habitat, or water quality trends. Fish tagging and/or marking studies have been designed and implemented by several agencies and governments in the upper and lower St. Marys River. Several studies have evaluated lake whitefish and lake herring populations and spawning habitat in the St. Marys River (Gleason et al. 1980a; Fielder 2000; Mark Ebener, ITFAP, Sault Ste. Marie, MI, personal communication).

Creel and fish harvest surveys have not been conducted regularly in the St. Marys River. The OMNR conducted sport fish creels in the St. Joseph Channel in 1978, 1979, and 1988, a sport fish creel survey of the St. Marys Rapids in 1985, and an aerial survey of fishing pressure in the North Channel in 1990 (OMNR, unpublished data). The MDNR conducted open water surveys in the St. Marys River in 1987 (Rakoczy and Rogers 1988) and 1991 (Rakoczy 1992) but did not include the St. Marys Rapids or the upper St. Marys River. In 1989, the LSSU-ARL completed a September-November Atlantic salmon angler harvest survey for St. Marys River waters between the Edison Sault Power Facility and Six Mile Point. In 1999, the SMRFTG proposed and implemented the first full-river harvest survey that was designed to collect information from the open water and ice angling fisheries, the tribal commercial and subsistence fisheries, the Ontario commercial fishery, and the First Nation commercial and subsistence fishery (SMRFTG report in progress).

Habitat Assessment and Rehabilitation Projects. – Few aquatic and riparian habitat assessment and rehabilitation projects have occurred in the St. Marys River. Some studies have been designed to evaluate effects of commercial vessel navigation and dredging (Gleason et al. 1980b; Gleason et al. 1982). United States and Canadian sea lamprey control agents collected habitat information in association with larval lamprey habitat mapping in 1991-1998. The Flora and Fauna Task Team of the St. Marys Remedial Action Plan completed habitat mapping between 1993 and 1995 (OMNR, unpublished data). Wetland evaluations were conducted by the OMNR in the lower St. Marys River in 1993 and the evaluations were updated in 1997 by Department of Fisheries and Oceans Canada (DFO) to assist with identification and protection of wetlands (OMNR, unpublished data). In 1998, the

United States Army Corps of Engineers (USACOE) began stabilizing sediments around Moon Island using rock berms (Stan Jacek, United States Army Corp. of Engineers, Sault Ste. Marie, MI., personal communication). The OMNR and DFO cooperated with local landowners to identify degraded riparian habitat (Doug Geiling, DFO, Sault Ste. Marie, ON, personal communication).

Stocking of Fishes. – Fish stocking has been conducted by several agencies in the St. Marys River for many years. Agencies reporting stocking activities included CORA (walleye), MDNR and LSSU [walleye, rainbow trout (steelhead and Michigan domestic strain), chinook salmon, and Atlantic salmon], OMNR (brown trout), and the Sault Ste. Marie Canada Municipal Hatchery (chinook salmon, brown trout, and rainbow trout). Stocking seasons, locations, number, size, age, strains, marks, and objectives have differed among agencies and governments. Unfortunately, uniform stocking criteria and population goals have not been identified among managing agencies and governments.

Sea Lamprey – Sea Lamprey assessment activities have occurred in the St. Marys River since 1962. In 1962-1964, surveys conducted by the United States Fish and Wildlife Service (USFWS) and DFO indicated that larvae were present in the upper River to Sugar Island (Schleen et al. in press.) Movement and tagging studies (Moore et al. 1974) as well as surface trawling to capture pre-spawning phase sea lampreys began in 1963. Larval surveys were continued in the 1970s and 1980s utilizing granular Bayluscide and other methods to further define distribution. Between 1970 and 1985 annual ' spot treatments' of high-density larval populations, utilizing granular Bayluscide were conducted on the Canadian side of the upper and lower river.

Trapping of adult spawning-phase sea lamprey to estimate the size and composition of annual spawning runs has been conducted since 1975 by employing traps at the Great Lakes Power and USACOE hydroelectric facilities. (Schleen et al, in press) Fyke netting from navigational buoys has been conducted since 1983 to collect and age transforming sea lampreys (Schleen et al, in press). Mid-water trawling for transformers was also conducted in 1988 and 1989 by DFO and USFWS personnel.

Between 1992 and 1997, intensive sampling of suitable habitat with deepwater electrofishing gear allowed the larval population to be mapped (distribution, densities and population parameters) (Fodale et al. in press). Development of a computer flow model helped to predict movement and mixing (and thus effectiveness) of possible TFM applications in the river (Shen et al. in press). In 1995 and 1996, lab and field trials were conducted to assess the effectiveness of a new improved formulation of granular Bayluscide (Schleen et al. in press). Some limited bottom trawling was conducted in 1996 to assess and predict effects of treatments on non-target species. As a result of these extensive studies, almost 800 surface hectares containing high densities of larval sea lampreys were treated utilizing aerial (helicopter) application techniques in 1998 and 1999 (Schleen et al. in press).

Environmental Monitoring - A variety of environmental monitoring projects have been conducted in the St. Marys River. The International Joint Commission declared the St. Marys River an Area of Concern (AOC) in 1985. In addition, the Great Lakes Water Quality Agreement between Canada and the United States stipulated that each AOC must have a Remedial Action Plan (RAP) to restore the beneficial uses including addressing the remediation of contaminated sediments. Several assessments

have been conducted as baseline studies for potential remediation or evaluation of contaminated sediments in the St. Marys River (McKee et al. 1984; Oliver et al. 1987; Jaagumagi et al.1991; Beak Consultants Ltd. 1990; 1993; 1996; ITS 1998; Kauss et al. 1999a; 1999b). Another source of extensive assessments on the U.S. side of the river can be found in studies conducted for the Cannelton Industries Superfund site (NOAA 1998, USEPA 1995).

Additional studies have occurred to evaluate potential impacts of vessel navigation and dredging in the St. Marys River (Hiltunen 1979; Liston et al. 1986). A study by Hiltunen and Schloesser (1983) related distribution of *Hexagenia* nymphs to oil contaminated sediments in the river. The Upper Great Lakes Connecting Channels Study (UGLCCS) also conducted assessments of sediments and benthos (Edsall et al. 1988; Kauss and Hamdy 1991; UGLCCS 1988). The most recent USACOE environmental assessment for dredging activities in the St. Marys River (USACOE 2000) defers to an assessment by Aquatec (1992) regarding contaminants in the sediments. Public Works Canada and the Canadian Coast Guard issued a report pursuant to Canada' s Environmental Assessment and Review Process regarding the quality of sediments in the river (M.M. Dillon Ltd. 1993).

Canadian and U.S. authorities monitor water quality and discharge from local industries and municipalities. The Ontario Ministry of Environment (OMOE) regulates sewage treatment plants in Ontario. The sewage treatment plant in Sault Ste. Marie, Michigan is regulated by a National Pollution Discharge Elimination System (NPDES) permit issued and administered by the Michigan Department of Environmental Quality (MDEQ). Point source discharges at Algoma Steel Inc. and St. Marys Paper Ltd. are under regulation by the Municipal Industrial Strategy for Abatement (MISA). St. Marys Paper Ltd. is also under control of the federal Environmental Effects Monitoring (EEM) program. Monitoring of contaminants in sport-targeted fish in the St. Marys River is conducted periodically by the MDEQ (MDEQ 1998), the Ontario Ministry of the Environment (OMOE 1999), and the DFO. In addition, there have been other contaminant assessments conducted including a study of walleye by the Inter-Tribal Fisheries and Assessment Program (ITFAP 1998) and spottail shiners (Suns et al. 1991).

Existing Fish Population Characteristics and Information Needs

The St. Marys River supports a diverse fish community with cold, cool, and some warm water species. Unfortunately, limited information exists that define our understanding of how existing fish populations are affected by loss of habitat, water quality, exploitation, and management actions. Increased assessment and monitoring of existing fish populations including, sport, subsistence, and commercial fisheries, habitat, and water quality will be necessary to improve our understanding and support holistic management of the St. Marys River' s fisheries.

Walleye. - Walleye are an important predator in the St. Marys River. They are known to migrate into the Munuscong River to spawn, as well as in the Garden, Echo, Bar and possibly Root Rivers, however, all migrations, except in the Munuscong River, have been reported to have greatly declined in recent years (OMNR, unpublished data). Abundance of walleye has not fluctuated significantly river-wide. When examined by area, however, assessment data collected since 1975 indicates that walleye

numbers appear to be on the increase in the upper reaches (Fielder and Waybrant 1998). More recent trends have indicated stable abundance of walleye in 1996-2000 in the upper river (Gebhardt 2000). Hatchery fish, marked with oxytetracycline in recent years, have comprised as much as 60% of the year class strength (MDNR, unpublished data) and as high as 86% in some locations within the upper river (Gebhardt 2000).
Total annual mortality of walleye from the 1995 fish community survey was estimated to be 51%. This was considered high relative to other notable Great Lakes walleye fisheries (Fielder and Waybrant 1998) although more recent estimates from one location, Waishkey Bay, documented the rate at 45% (Gebhardt 1999). Abundance of mature female walleye is low. Only 7.5% of the population is above the age at which females typically mature. This is considerably less than other Great Lakes walleye populations and suggests that the walleye population may be brood-stock limited (Fielder and Waybrant 1998).

Slow growth of walleye may also contribute to the low abundance of mature fish. Compared to the average growth rates in Michigan waters, St. Marys River walleye grow slowly and the rate has declined for age 2-4 fish since 1979 (Fielder and Waybrant 1998). Some improvement in growth has been observed in Waishkey Bay in 1998 but growth is still considered slow (Gebhardt 1999).

In addition to updating the aforementioned parameters, more information is needed on movement of walleye, and their annual exploitation rate (particularly of individual spawning migrations or stocks). Seasonal walleye diet information is also necessary to better understand growth and maturity. Since 1997, walleye stocking by CORA has utilized the Munuscong River brood source helping to minimize any negative genetic consequences of the stocking.

Yellow Perch. - Yellow perch abundance has been largely stable except for a brief period of increased abundance in 1987 (Fielder and Waybrant 1998, Gebhardt 1999). River-wide, yellow perch total annual mortality was estimated to be 38%, however, it increases from upstream to downstream locations (Fielder and Waybrant 1998). This is reflective of patterns of fishing pressure from the sport fishery that generally increases from north to south along the expanse of the river. Total annual mortality reaches a high of 60% in Potagannissing Bay.

Fielder and Waybrant (1998) reported yellow perch growth rate at or near the average for Michigan waters. More recent information from the area above the locks, however, has indicated a below average growth rate (Gebhardt 1999). All population parameters for yellow perch need to be updated. Estimates of exploitation and movement would also be desirable although are typically difficult to obtain for this species.

Northern Pike. - Northern pike are an important member of the St. Marys River fish community and fisheries. This species has experienced no significant change in abundance on a river-wide basis between 1975 and 1995 (Fielder and Waybrant 1998, Gebhardt 2000). Examined by area within the river, however, northern pike have experienced a significant decline in the Potagannissing Bay region between 1987 and 1995. Gebhardt (2000) reported that abundance of fish smaller than 51 cm has declined annually since 1997 in the upper river, suggesting poor recruitment. Total annual mortality of

northern pike was estimated to be 58% in 1995. Northern pike that year, were growing well below the average for Michigan pike populations (Fielder and Waybrant 1998). Updated information is needed for all northern pike population parameters.

Lake Herring. - The St. Marys River remains a stronghold for lake herring in Lake Huron. In 1995, lake herring abundance was not significantly different from that in the previous survey years (Fielder and Waybrant 1998). Total annual mortality was higher in Potagannissing Bay than that calculated for the rest of the river, but both values were generally low for lake herring populations (Fielder and Waybrant 1998). Lake herring were found to grow at a rate much faster than the Michigan average for the species. The environmental conditions in the St. Marys River appear to be ideal for lake herring growth. All population parameters are in need of updating for lake herring.

Smallmouth Bass. - The 1995 fish community survey indicated a significant increase in abundance of smallmouth bass relative to surveys conducted in the 1970s. Total annual mortality of this species was relatively low in 1995 at just 36% (Fielder and Waybrant 1998). Growth rate estimated in 1995 were generally below the state average for Michigan. All population parameters are in need of updating.

Other Salmonines. – The St. Marys River supports notable spawning runs of Atlantic salmon and Pacific salmonines. The Pacific salmonines include chinook salmon, coho salmon, pink salmon, steelhead/rainbow trout. In addition to these species, brown trout, splake, and pinook salmon (chinook salmon X pink salmon hybrid) also occur in the St. Marys River, although at low levels. Brook trout, once an abundant resident of the river have all but disappeared. With the exception of rainbow trout and brown trout, salmonines do not reside year round in the St. Marys River. Population abundance of each species typically peaks during fall or spring spawning migrations.
Relative abundance gillnet indices for pink salmon have clearly shown that the two-year spawning cycle has been replaced by annual spawning, with runs greater in even years (LSSU, unpublished data). No distinct annual trends in spawning abundance have been observed for other salmonines. However, the frequency of naturally reproduced Atlantic salmon has increased over the past two years. Because salmonines, in particular chinook, pink, and Atlantic salmon are very popular with sport anglers, additional studies are needed determine the population characteristics and dynamics of these species.

Muskellunge. - Muskellunge have never been abundant in fish community surveys conducted since 1975 (Fielder and Waybrant 1998). Some muskellunge were collected in the 1979 fish community survey but were recorded as tiger musky (Miller 1981). Sport anglers did harvest an estimated 34 muskellunge in July 1999 confirming their presence. Little is known about this species in regards to its abundance or limiting factors in the St. Marys River. Given the abundance of northern pike in the river, it might be inferred that suitable habitat conditions also exist for Great Lakes muskellunge. This species, popular with sport anglers, needs additional study to determine the exact extent and source of fish for this population.

Lake Sturgeon. - Lake Sturgeon abundance has steadily declined since the 1975 fish community survey until finally no fish were sampled in 1995 (Fielder and Waybrant 1998). However, two individuals were collected in August 2000 by LSSU-ARL researchers during sturgeon assessment

activities near Lake George. Little is known about this species in the St. Marys River including whether or not they are still spawning successfully or if present population members are merely survivors of earlier cohorts of this long lived species. Lake Sturgeon are still fairly abundant in spawning runs in the Mississauga River, 60 kilometers east of Bruce Mines, in Ontario. The status of this species in the St. Marys River needs to be assessed as well as what role the region might play in a planned recovery of the species by management agencies.

Sea Lamprey. - Sea lamprey use the St. Marys River for spawning and nursery purposes. Consequently, mature adults can be quite abundant at times, although they are not parasitic during spawning migrations. Juvenile transformers are parasitic, however, and have been documented to parasitize lake herring (MDNR, unpublished data). Although the production of sea lamprey from the St. Marys River has been a serious problem for salmonine management in Lakes Huron and Michigan, the overall presence of migrating adults in the river is not believed to be a significant factor affecting the rest of the river's fish community.

Prey Fishes. - Current information on the status of prey fishes in the St. Marys River fish community is limited. Seining surveys in the upper river in 1995- 2000 documented 28 forage fish species (BMIC 1997) It is known that alewife and rainbow smelt will inhabit the river below the locks at least seasonally. In fact, these species comprised a substantial proportion of the diet of walleye and northern pike during August 1995 (Fielder and Waybrant 1998). Other prey fish observed in stomach contents included the ninespine stickleback, trout-perch, slimy sculpin, and johnny darter. In addition, juvenile and adults of other species such as white suckers, yellow perch, walleye, and smallmouth bass were consumed by northern pike in 1995. Liston et al. (1986) trawled much of the St. Marys River and collected various shiners in addition to the species mentioned above. Many of the obligate piscivorous fishes in the 1995 survey exhibited slow growth rates. It is not clear whether this could be directly attributed to limitations in the prey base or a shorter growing season compared to much of the rest of the range for these species. More information is needed on the prey fish assemblage, their abundance, and seasonal usage of the river by migrating species such as rainbow smelt and alewife.

Zooplankton and Macroinvertebrates. - Information on the zooplankton and macroinvertebrates of the river comes mainly from studies investigating species specific questions. Extensive monitoring of sea lamprey ammocoete density has produced some information on the assemblage of benthic macroinvertebrates. Only Liston et al. (1986) attempted a more comprehensive investigation of these trophic levels and provided good baseline information. They described densities and species composition at various stations in the river. Some of the taxonomic groups documented were Odonata, Lepidoptera, Coleoptera, non-chironomid Diptera, various mollusks, Trichoptera, and Chironomidae. These studies provide some baseline for comparison. Replication of sampling procedures may provide an indication of any trends in numbers of these important ecosystem members. A better understanding of these trophic levels will assist in assessing the fish community dynamics and potential production.

Other Exotic Species. - Other notable exotic species such as the round goby, the Eurasian ruffe, zebra mussel, and the spiny water flea are all in need of monitoring in the St. Marys River. Little is known about their full status and even less on their impact to the existing aquatic community. Future

investigations in the St. Marys River should assist in determining the extent to which newly invaded exotic species are present and how they affect the aquatic community.

Identification and Prioritization of Fishery Stressors and Concerns

The SMRFTG was responsible for compiling and reviewing fishery stressors and concerns that were identified by public stakeholders and agencies. The Task Group consulted with various stakeholder groups at public meetings to assist in identifying and prioritizing all fishery issues (Greenwood 2002). In addition, SMRFTG members were responsible for prioritizing fishery stressors and concerns, evaluating assessment and information needs, and proposing assessment actions to local fishery management agencies and other organizations, universities, and experts when necessary. The following are the prioritized concerns identified.

1. Healthy sustainable fish communities and fisheries supported by a sustainable aquatic food webs;
2. Quantity and quality of aquatic habitat to support sustainable fish communities;
3. Water chemistry and water quantity and quality;
4. Exotic species;

Proposed Assessment Actions

It was the goal of the SMRFTG to propose an extensive assessment plan that recognized all projects necessary to address identified fishery stressors and concerns regardless of available agency funding, staff, and time. Recognizing that existing agencies are not capable of conducting all proposed assessments, the FMAs delineated the projects between those representing management information needs (those likely to be pursued by management agencies) and other generalized information needs (those that will likely need investigation by academia or others to fulfill). The Task Group has also identified minimum sampling requirements for each proposed project when possible, identified agencies or groups likely to conduct the assessments, or has invited other outside agencies, universities, and researchers to contribute expertise, staff, and funding to complete the proposed assessment projects. Appendix 3 summarizes proposed surveys, participating agencies, and frequency of sampling.

Concern: Healthy Sustainable Fish Communities and Fisheries Supported Sustainable Aquatic Food Webs

Sustainability of the fish community and its forage base was the principle priority identified by virtually all stakeholders and SMRFTG member agencies. Continuation of existing and implementation of new fishery assessment and monitoring projects is necessary to evaluate sustainability of fish populations in the St. Marys River.

Goal: Develop long-term monitoring programs to evaluate the dynamics of existing and future fish populations and the organisms on which they depend in the St. Marys River.

Assessment Actions (M= Management information need, G =general information need)

- Fish Community Survey -M
  - -Gillnet Assessment - M
  - -Bottom Trawling - M
  - -Seine Survey - G
  - -Electrofishing Survey - G
- Stocking Evaluations - M
- Early Life History Surveys - G
- Fish Harvest Surveys - M
- Fish Tagging Studies – M & G
- Benthic Macroinvertebrate Surveys - G
- Zooplankton Surveys - G

Fish Community Survey

A regular survey of the St. Marys River fish community was considered a top priority by the SMRFTG. Ideally, this survey should be jointly conducted every year with a minimum of once every three years. The survey should be conducted by local tribal, state, federal, and provincial agencies. A variety of assessment projects are necessary to assess changes in the status of the population of each species. This survey is fundamentally different from a survey of harvested fishes because it utilizes a variety of gear to collect adult and juvenile specimens of many species, collects non-game species, and hopefully collects specimens in proportion to their true abundance. Specific biological information should be collected from all fish species captured (Table 1). The fish community survey should follow the approximate methods of Fielder and Waybrant (1998), a gillnet survey, but be expanded to include additional sampling of juvenile and forage fishes by trawling, seine, and electrofishing gear. If possible, all proposed assessment projects within the fish community survey should be conducted concurrently.

Table 1: Required fishery information collected for target and nontarget fish species during fish community surveys on the St. Marys River.

Measurement	Target species	NonTarget species	Used in what parameter
Total length	X	X	Growth rate determination (length-at-age), size structure of population, recruitment, harvest regulation design, condition.
Age (from bony structure)	X		Growth rate determination (length at age), age structure of population, recruitment, total annual survival, total annual mortality, maturity & reproduction potential
Total (round) weight	X		Weight/length regression, growth rate determination, condition, can aid in the design of harvest regulation.
Sex	X		Necessary for assessing reproductive potential, aids in identifying population level stress or decline, necessarily for interpreting growth rate, necessary for assessing maturity level.
Maturity	X		Necessary for assessing reproductive potential, for identifying populations in distress, aids in design of harvest regulations when combined with age or length.
Stomach contents	X		Important for assessing diet preferences, identification of prey limitations, implications for understanding forage base, can sometimes be an indicator of the presence of exotic species.
Visceral fat index (some species)	X		Condition
Lamprey wounding	X	X	Indicates vulnerability to lamprey attacks, helps partition mortality sources, helps gauge lamprey abundance
Visible disease examination	X		Helps to assess incidence of certain diseases in some species like tumors, lymphocystis, Myriofibulagranuloma, parasites.

Gillnets -Variable mesh gillnets will be employed for fish community surveys in the St. Marys River each year. Gillnet meshes will be graded to collect a large span of sizes and ages, including juveniles of many species. The use of gillnets as the principle means for assessment in future surveys will have the added benefit of allowing a more direct comparison to much of the past survey work.

Gillnet gear will be similar to that described by Fielder and Waybrant (1998) to facilitate comparability to previous surveys. Those nets are 305-m long by 1.8-m deep and constructed on multi-filament nylon material. Each net should be comprised of 31-m panels of 38.1-, 50.8-, 63.5-, 76.2-, and 114.3-mm stretch-measure mesh hung on the half basis. In addition, 88.9-, 101.6-, 127.0-, 139.7-, and 152.4 -mm stretch-measure panels should be included in each gillnet gang. All nets should be fished on the bottom overnight.

The full complement of data summarized in Table 1 should be collected from all target fish species; walleye, lake herring, northern pike, yellow perch, smallmouth bass, lake sturgeon, muskellunge, and all salmonines captured when possible. Data measurements
can be added for all or specific fish species when and if management issues arise. All non-target species will be measured for total length only. Relative abundance as indicated by catch-per-unit-effort (CPUE) will also be included and expressed and assessed for all species encountered.

River-wide, a total of 45 gillnet sets will be performed in August of each year. The net sets should be located according to Appendix 4; Figure A. It is recommended that data analysis and reporting follow that of Fielder and Waybrant (1998). When sample sizes are sufficient, analysis and reporting should be subdivided among the following 7 river reaches: upper river, Lake Nicolet, Lake George, St. Joseph Channel, Lake Munuscong, Raber Bay, and Potagannissing Bay. All parameters should also be summarized for river-wide totals or averages.

Trawling -Trawling should occur in the St. Marys River following the schedule for the proposed gillnet assessments to obtain abundance and population data for juvenile fishes, prey species, and other small, sedentary, or demersal species that are often not captured by gillnets or are under represented in other surveys. Some species caught by trawling in the St. Marys River in the past have included trout-perch, johnny darter, ninespine stickleback, yellow perch, spottail shiner, mottled sculpin, and mimic shiner (Liston et al. 1986). Trawling is an effective means to sample these types of species and can often serve as a more representative measure of recruitment and prey fish abundance.

Trawling should be performed with a semi-balloon otter trawl having a 4.9-m head rope, 38-mm stretch mesh body, and 6 mm stretch-measure mesh cod end liner. Sampling with the trawl should follow the methods of Liston et al. (1986) including a 5-minute trawl time at approximately 2 knots.

Trawling locations depicted on Figure B in Appendix 4 include those originally surveyed by Liston et al. (1986) (sites 2, 7, 8, 10, 13, 14, and 15), but are expanded to provide a more complete coverage of the river and its habitats. Each site should be sampled with four replicate tows in the month of August each year. Fish collected will be identified and enumerated and total weight and number of each species will be recorded by haul. A random sample of up to 50 individuals of each species for each station will be measured for total length, weight, and sex. Scale samples and or other necessary bony structures should be collected from any of the target species collected for aging.

Data analysis should include CPUE summaries by species for each location and compared to previous years. Length frequencies of each species should be summarized for each reach of the river. Analysis

should include age and length-at-age summaries for the target species. Analysis and reporting of trawl catches and data should be handled separately, but compared and contrasted with collections from other gears.

Seine Survey –Seine surveys should be conducted at nearshore locations at established trawling sites each year (Appendix 2; Figure B). Seine surveys will be important for collecting juvenile fishes and some prey species that are not vulnerable to trawl gear or occupy shallow water habitats. At least three seine hauls should occur near each trawl site with a 30.5 m long, Delta knotless 9.5- mm stretch mesh bag seine during the fish community survey. Data collection and analysis should follow methods described for trawl catches.

Electrofishing - Electrofishing gear should be employed when or where the other collection gears prove ineffective. As with trawling and seining, electrofishing permits evaluation of recruitment at younger ages and abundance and diversity of some prey species. Some fish species are not highly vulnerable to gillnets or trawling gear. Adult smallmouth bass is an important species in the St. Marys River that exhibits this tendency. Should additional assessment be necessary for this or similar species, a separate electrofishing survey could be developed and implemented. The sampling protocol should be designed to represent the entire river. Analysis and reporting should follow that of the gillnet survey.

Stocking Evaluations

The SMRFTG considered stocking evaluations to be a high priority assessment project because the St. Marys River is the site of considerable stocking of walleye and salmonines. Understanding the sources and success of recruitment of wild fish are fundamental to fully understanding the overall fish community dynamics. When a species is partially managed with stocking, evaluating the contribution of those hatchery fish then becomes an important element of assessment. The success of stocking and the contribution of stocked versus wild fish to each population in the St. Marys River should be evaluated regularly. The following stocking evaluation protocol is suggested.

Walleye -Walleye stocking should employ oxytetracycline (OTC) marking every year to permit the recognition of hatchery recruits and the differentiation from naturally produced (wild) fish. Marking of walleye fingerlings should be performed according to the methods of Fielder (2002). Mark comparison should be performed in late summer / fall for age-0 fish and be performed each year up to age 3. Specimens can be collected from a variety of gears and pooled across gear types. At least 20 recruits per river reach (defined in the fish community survey above) are recommended for collection. Collection efforts should be distributed throughout the river to avoid over sampling hatchery fish that are often patchy in their first year distribution. Specimens should be frozen until analysis.

Since multiple marked year classes are simultaneously at liberty, scale and dorsal spine samples should be included with fish age-0+ so as to allow results to be credited to the appropriate year class. Data summaries should be organized by sample location to accurately depict the relative ratios of hatchery fish to wild fish throughout the river. The marking evaluation approach can be supplemented with an

alternate year stocking evaluation should management agencies desire that additional assessment approach. If multiple study groups are stocked, differential marking might be considered.

Salmonines -Stocking of salmon and trout species has been taking place in the St. Marys River and Lake Huron for many years by a variety of agencies and entities. It is now necessary to adopt a uniform protocol for evaluating stocking programs and to determine the contribution of stocked versus wild fish. Efforts are now underway in Lake Huron to implement a uniform protocol for marking, tagging, and recovering stocked salmonines. Tag returns and fin clip information collected from anglers, spawn collection activities, and the commercial and subsistence fisheries can be used to estimate relative survival, growth, distribution, and origin of fish. Tag returns can be contrasted between those in the river and those from Lake Huron, and can also be compared between fisheries.

Early Life History

Early life history surveys were not considered a likely management agency information need by the FMAs. Study approaches are therefore not specifically identified in this plan and are probably better saved should specific questions arise in the future. Opportunities and needs exist for academia and others to propose specific project proposals relevant to current and future fishery concerns. Questions of early life history of fishes can be addressed using ichthyoplankton sampling and egg sampling. Methods and some baseline data for larval fish abundance in the St. Marys River can be found in Liston et al. (1986) and Jude (1988, 1998).

Fish Harvest Survey

A fish harvest survey, employing several methods, was considered a management agency information need by FMAs. A critical element of providing for a healthy, sustainable fish community is a full understanding of total harvest or extractions from a fish community and it' s populations. The St. Marys River is home to sport fisheries in both Michigan and Ontario waters as well as tribal and First Nation subsistence fisheries. Neighboring commercial fisheries likely also exploit some of the same stocks of fish. Only by careful monitoring of these extractions can effective and equitable management actions be designed. A survey of fish harvested should employ a sport creel survey as well as reporting of subsistence and commercial harvest.

Sport Creel Survey –Sport creel surveys should be conducted every year by local fishery management agencies in the St. Marys River. Future creel surveys should follow the design and procedures used in the 1999-2000 survey conducted by the SMRFTG member agencies. The survey should be based on the methods of Lockwood (2000) and Rakoczy (1992). The survey follows a stratified design of creel survey interview and aerial counts for estimating fishing pressure. Strata included 7 river reaches generating 7 sets of estimates that were combined for river-wide totals (Appendix 4; Figure C). The creel survey can also provide some measure of the harvest from the sport-gear subsistence fisheries. Creel survey analysis provides estimates of angler catch rates, release rates, targeted effort, and total number of fish harvested. It also provides estimates of fishing pressure. Two types of data should be collected during the harvest survey, including angler-party interviews and angler or boat counts. Angler

data will include mode of fishing, where they fished, how long they fished, target species, number of each species kept, number of fishing trips each day, age of angler, sex, zip code, nationality, license type, angling method, and number of lines fished. Biological data, including length, weight, sex, maturity, condition, finclips, lamprey wounds, and aging structures should be collected from all target species harvested on a quota basis of 25 specimens per month per site (yielding total of 1,050 specimens for the open water season). The creel survey should span the months of May through October (open water survey) and January through March (winter or ice survey). Periodic spot checks of known angling locations such as the rapids during other months may be considered to ensure accuracy of total annual harvest. Together, this span effectively surveys the vast majority of fishing activity. Measurements of catch rate provide an indication of the quality of fishing. Harvest and fishing pressure can be expressed on a per area basis for comparison to similar Great Lakes fisheries. All statistics can be compared to previous survey results to examine for trends and for effects of harvest regulations.

Subsistence Harvest Reporting - To supplement the creel survey's estimates of harvest, tribal and First Nation subsistence fishers are required to annually report their harvest by April of the following year. Subsistence harvest reporting should include gear, effort, species harvested, number or weight of fish harvested, and location.

Commercial Harvest Reporting – Agencies, governments, tribes, and First Nations responsible for managing commercial fisheries in or near the St. Marys River should also report annual harvests by April of the following year. Commercial harvest reporting should include month, location, grid, days fished, effort, gear, and total harvest of each fish species. By combining harvest reports, total extractions can then be determined. Combined estimates of yield are necessary for including the St. Marys River fisheries in comparison to the Lake Huron Fish Community Objectives (DesJardine et al. 1995). First Nation subsistence and commercial fish harvest report is more elusive. The SMRFTG should continue to work with First Nations to encourage and include their reporting.

Tagging Studies

Fish tagging studies were considered an important fishery assessment project by the SMRFTG. Tagging studies serve to evaluate exploitation, mortality, movement, and stock delination of important fish species. Tagging adult fish provides several measurements and analysis opportunities that can be integral to understanding fish populations. A walleye tagging program is in order for stocks which are facing recovery efforts, modeling efforts, or more intensive management. Returns of tags by anglers, subsistence and commercial fishers will allow the calculation of exploitation rates. Exploitation rate is necessary for further assessing the scale of a fishery and if the harvest is at a sustainable level. Exploitation rate is also a parameter often used in modeling efforts. Tag returns also provide an opportunity to determine relative exploitation by competing fisheries and some measure of movement and habitat use. By plotting return locations, one can see how the fish distribute themselves (relative to fishing pressure) throughout the year. This can facilitate managers in identifying stocks and determine the geographic scale of needed and common harvest regulations for both jurisdictions.

Estimates of total annual fishing mortality based on catch-curve (age data) analysis is tenuous because it makes the unlikely assumption that each year class is the result of constant or equal recruitment. One way to overcome this obstacle and obtain more precise measurements of mortality is to complete a matrix of multiple year tag returns allowing the generation of year-specific estimates of survival and mortality (Brownie et al. 1985). This requires several years of consecutive tagging and recovery data.

Walleye Tagging - Walleye should be tagged each year during their annual spawning migration into the Munuscong, Bar, Echo, Garden Rivers, and Potagannising Creek in March and April. Collection programs for spawn to supply Nunn's Creek Tribal Fish Hatchery might also double for part of the tagging effort. The Munuscong River migration of walleye is thought to be the principle source for the St. Marys River and the northwest portion of Lake Huron (Schneider and Leach 1977).

Tagging needs to take into consideration current length limit regulations in the river. Generally tagging is limited to only those fish vulnerable to the fishery. The larger the sample size, the more robust and useful the tag return data is. At least 1,500 walleye, should be tagged from the combined stocks throughout the St. Marys River each year for 10 years. For a fishery the size of the St. Marys River, an annual tagging of 1,500 walleye would be a minimum. Tagging should be done with serially numbered monel metal tags inscribed with a postal return address, and attached to the maxillary bone. Biological data such as length, sex, scales, and dorsal spines should be collected and referenced to each tag number. Age of the fish will be necessary to determine age specific parameters including the calculation of year-specific survival rates. Upon receipt of a tag or reported number from an angler, it is customary in such programs to reply with an informational thank you letter and a reward.

Analysis and calculation of year-specific survival and mortality estimates should be completed with the computer program ESTIMATE (Brownie et al. 1985). Movement can be expressed by two-dimensional plotting and can best be analyzed in a geographic information system (GIS) system. Tagging investigations as described here can also be applied to other species, providing suitable numbers of adults can be efficiently collected.

Lake Sturgeon Tagging – Lake sturgeon are also in need of stock identification, movement analysis, and exploitation estimation. Lake Sturgeon have been the subject of some tagging effort by LSSU in recent years. This initiative should be endorsed and if possible, expanded so as to further the progress of understanding the stock delineation of this important species. Recommended is collaboration between FMAs and LSSU to determine how best to continue this work in the future and to collaborate with other lake sturgeon tagging operations in process in Lake Huron, Lake St. Clair, and the Detroit River.

Benthic Macroinvertebrates and Zooplankton

Benthic macroinvertebrate and zooplankton surveys should be conducted during the fish community survey. The SMRFTG urges academia and others to cooperate with local fishery management agencies

to develop, propose, and implement invertebrate assessment projects to address current and future fishery concerns. The following is the recommended design and approach.

Macroinvertebrate abundance and diversity should be measured at standard locations in the St. Marys River (Appendix 4; Figure D). Benthic macroinvertebrates are critical elements of the aquatic community, serve as important food items for many fish species, and can provide a valuable indicator of habitat and aquatic ecosystem health. Their assessment will be an important component for understanding the overall food web in the fish community. Baseline work on the benthic macroinvertebrate community was performed by Liston et al. (1986). That work provides a suitable methodology and sampling regime for continued monitoring as well as data for comparative purposes. Proposed assessment work for these important members of the food chain is based on that methodology.

Transects for benthic macroinvertebrate sampling are suggested in Appendix 4; Figure D . They include those originally used by Liston et al. (1986) as well as four additional transects to provide better coverage. Each transect samples the upper littoral zone (area containing emergent aquatic macrophytes) and the lower littoral zone (area beyond emergent macrophytes). Some transects include a third zone, the navigation channel. Different collection gears are proposed depending on the zone. Each transect includes up to 7 actual sample sites. Each site should be sampled in triplicate in the month of August each year.

The upper littoral zone should be sampled for two forms of invertebrate colonization; sediments and plant surfaces. The sampling of sediments should be performed with an Ekman Grab that samples a 232 cm^2 area. Sampling macroinvertebrates from macrophytes should be done with a modified Gerking sampler. This sampler consists of a Plexiglas box that is open at the bottom and top and encloses an area of 484 cm^2. Sliding doors attached to the bottom of the sampler and a 150 µ mesh plankton net is attached at the top. The Gerking sampler is lowered over aquatic macrophytes and the doors are closed pinching off macrophyte stems. The sampler is then lifted and inverted allowing the vegetation and associated fauna to fall into the plankton net. Samples are rinsed into a plastic bag, refrigerated and returned to the laboratory. The lower littoral zone should be sampled with a standard Ponar Grab sampler enclosing an area of 484 cm^2. Retrieved samples should be rinsed into a plastic bag, refrigerated, and analyzed in the laboratory. Some transects may contain sample sites of large rocks or bedrock. Those sites will be omitted from sampling.

All samples returned to the laboratory should be rinsed through a standard number 30 sieve (600 µm mesh aperture). A 10% volumetric subsample of the resultant slurry from each sample should also be rinsed through 250 µm and 150 µm sieves and preserved. The resulting samples and subsamples should then be sorted, identified to the lowest taxonomic level practical (usually genus). Some categories may be lumped such as oligochaetes. Identified samples should then be enumerated. Counts from all sample sites should then be extrapolated to number per taxonomic group per square meter. Means should be calculated for the triplicate samples within sites. Summaries should be tabulated among zones, transects, river reaches, and years with statistical comparisons made where appropriate.

Zooplankton surveys should occur at standardized locations to evaluate abundance and species diversity and might utilize those for macroinvertebrate sampling. Zooplankton are also integral elements of the food web for many fishes and are of particular importance to the survival of larval fish. An understanding of the zooplankton community and their density can help identify limiting factors for some species. Baseline data is limited for the river, however, Jude (1988) did describe zooplankton resources in the river for part of a year.

Zooplankton should be collected at several locations in the St. Marys River with triplicate oblique tows of a Clarke-Bumpus zooplankton sampler equipped with an 80 µm mesh collection container. The Clarke-Bumpus sampler is equipped with an impeller connected to a meter allowing for volumetric expressions of zooplankton collections. The triplicate collections should be made at two locations within each transect used for sampling benthic macroinvertebrates. One sample should be made at the deepest location within the transect and one at the shallowest (no less than 1 m).

Samples should be preserved in sugar-buffered formalin (Haney and Hall 1973) and analyzed in the laboratory. Analysis should consist of 1 to 5 ml representative subsamples examined on a dissection microscope. Specimens should be identified to the lowest taxonomic group reasonable and enumerated. Densities of each taxonomic group should be extrapolated from the subsample and expressed for the total sample volume. Comparisons should be made between river reaches, depths, and years where appropriate. Frequency of the zooplankton sampling should coincide with the benthic macroinvertebrate surveys.

Concern: Quantity and Quality of Aquatic Habitat to Support Sustainable Fish Communities

Quantity and quality of habitat were identified by SMRFTG members and stakeholders as critical components of sustainable fish communities in the St. Marys River. It will be necessary to identify both the historical and current aquatic habitats in the St. Marys River to evaluate current conditions, develop future habitat goals, and to evaluate habitat restoration efforts. An earlier product of the SMRFTG was the development of a GIS database. The SMRFTG urges academia and others to cooperate with local FMAs to develop, propose, and implement assessment projects necessary to document historic and current habitats and information, and contribute to the GIS project.

The GIS database that has been developed for the St. Marys River incorporates historical and current habitats and biological information. This database is useful for tracking changes to habitat, fish populations, and water quality over time if updated regularly. The GIS project for the St. Marys River incorporates projections currently used by the MDNR Spatial Information Resources Center (SIRC). Recently a larger GIS project has begun under the MDNR to develop a GIS databases and projects for all of Lake Huron and its watershed. The previous St. Marys River GIS project will be absorbed and incorporated into the Lake Huron GIS Project. The SMRFTG recommends that Lake Huron GIS project continue to assist the SMRFTG and FMAs to further identify information needs, expand GIS

database capabilities for the St. Marys River, and assist in designing projects necessary to gather missing information.

Goal: Document historical and current aquatic habitats in the St. Marys River to provide a baseline for evaluating current and future habitat conditions.

Assessment Actions (M= Management information need, G =general information need)

- ?? Expand the existing habitat GIS database – M & G
- ?? Design and implement new habitat inventories and mapping projects to collect missing information and update existing records - G

Design and implement a habitat inventory and mapping project - It will be necessary to further document and quantify existing habitats in the St. Marys River with a variety of techniques and to track changes in habitat quantity, quality, and distribution through time. Future field habitat inventories and biological monitoring programs will be necessary to document physical, chemical and biological characteristics and verify information in newly constructed GIS imagery maps. The USACOE maintains a photographic record of the Neebish Island Channel. This database should be expanded to include the entire River or at least the channelized portion. Further substrate mapping and river flow studies will be required to address information needs including study of the peaking and pooling effects from compensating gate release operations. Cooperating agencies and governments will need to continually identify missing data layers and information necessary to evaluate management actions. Initial habitat inventories should be continued until all necessary habitat and associated biological information is collected. Substrate mapping and river flow studies may only need to be conducted once every ten years. The SMRFTG recommends that outside expertise, funding, and specific project proposals be requested for future field habitat inventories, aerial surveys, remote sensing, substrate mapping, and river flow studies. Funding proposals could be developed by FMA' s and used to employ seasonal survey and mapping crews or provide funding to qualified individuals or groups to complete the proposed work.

Concern: Water Chemistry and Water Quantity and Quality

The SMRFTG recommends that an multi-faceted, whole-river water quality and quantity monitoring program be adopted to ensure fishery sustainability in the St. Marys River. This should include monitoring of contaminants in; water, sediments, and aquatic biota. The Task Group recommends and supports proposed assessments identified in the draft Stage 2 RAP that specifically address water quality and quantity issues. In addition, the SMRFTG looks to the Environmental Objectives (EOs) development effort by the LHC, to the RAP, and to the International Lake Superior Board of Control to provide leadership in addressing needed assessments to achieve fisheries objectives as well as beneficial use objectives. It is believed that these assessment actions in addition to those proposed by the SMRFTG will assist in evaluating current and future water quality and quantity concerns in the St. Marys River.

Goal: Address existing water chemistry, quality and quantity issues in the St. Marys River by developing and/or enhancing a regular water quality sediment and aquatic biota monitoring program that includes recommendations from the Stage 2 RAP report. Assist and facilitate the development of EOs for the St. Marys River.

Contaminant pathway monitoring – The St. Marys River Stage 2 RAP Report identifies contaminants as historically and presently being introduced via two means; from point source locations such as the Cannelton Industrial Site, Algoma Steel Corp., St. Marys Paper and municipal outflows and non-point source additions from air and precipitation. These contaminants are detected as present first in the water and eventually as stored poisons in sediments and living organisms. Since water is the pathway which distributes contaminants to fish and other biota, including humans, monitoring programs that track changes in water quality, sediment condition and biota health are needed. The SMRFTG recognizes that local fishery management agencies and staff do not have specific expertise, staff, and funding to conduct many of the proposed assessment projects and invites outside agencies, universities, and experts to cooperate with local fishery management agencies to develop, propose, and implement future projects. As well, the Task Group and its fisheries management agencies support all efforts through the RAP process to coordinate and facilitate monitoring actions that will improve water quality and ultimately the quality of the fishery, while protecting human health.

Assessment Actions: **(M= Management information need, G =general information need)**

Specifically, the SMRFTG supports the following elements of the Stage 2 RAP:

?? Design and implement an annual river-wide ambient water quality monitoring program at standard locations in the St. Marys River, including monitoring at the Cannelton Industries Site - G

?? Conduct aerial monitoring of the Cannelton Industries Site - G

?? Design and implement a program to examine potential adverse effects to Aboriginal lands or water supplies – G

?? Monitor the receiving water every three years at St. Marys Paper Ltd. to document response of fish communities to improved effluent quality as mill upgrades and process improvements are implemented - G

?? Monitor effluent from East End Water Pollution Control Plant, in Sault Ste. Marie, Ontario, for concentrations and loading of persistent contaminants exceeding guidelines in Lake George Channel sediments - G

?? Monitor surface water, groundwater, wetland soils, and biota at the Cannelton Industries Superfund site to ensure protection of the ecological food chain. Conduct a site review (U.S. EPA) every five years to ensure that the remedy continues to provide adequate protection - G

?? Design and implement a monitoring system for storm water - G

?? Design and implement a river-wide survey to identify all contaminated sediments in the St. Marys River - G

?? Resample river sediments every five years to obtain trend with time information - G
?? Conduct further studies to characterize sediment quality in high priority areas (i.e., adjacent to Algoma Slag Dump, portion of Little Lake George Channel downstream of East End WPCP, and the Algoma Slip) - G

?? Conduct sediment quality and benthic community assessments at Algoma Steel Inc. to determine the effectiveness of contaminant removal and the need for further dredging - G

?? Periodically conduct benthic, toxicity, and sediment chemistry studies in the Bellevue marine Park area - G
?? Continue with sport fish contaminant monitoring programs in the St. Marys River and tributaries - G

?? Design and implement a biological monitoring program to ensure the protection of the aquatic food chain from contaminates - G

?? Organize findings from above projects into the existing GIS project. – M & G

Goal: Address existing water quantity issues in the St. Marys River by working with the International Joint Commission and the International Lake Superior Board of Control to mitigate the impact of peaking & pooling extremes in water supply to the rapids and lower St. Marys River during critical life cycle periods.

Monitoring water quantity –As a connecting channel, water levels in the St. Marys River reflect the water supply from Lake Superior as regulated by the International Lake Superior Board of Control. The Board' s approach has been to attempt to "balance the levels of Lakes Superior and Michigan-Huron about their mean levels, giving consideration to their natural ranges." (IJC 2001). Fisheries concerns in the St. Marys Rapids were recognized in 1990 with adoption of the current Lake Superior regulation plan, Plan 1977A. This marked a considerable improvement in ensuring sufficient water for some critical life processes over the long term. However, issues remain around short and medium term flow alterations in the rapids, for maintenance and study purposes and water level changes affecting riparian, wetland and littoral habitats in the lower river. The International Lake Superior Board of Control of the International Joint Commission could contribute to addressing these fisheries concerns through their expertise in regulating water levels in the Great Lakes.

?? Design and implement studies to evaluate the influence of water levels and flow rates on spawning and fish production in the St. Marys River and St. Marys Rapids - G

?? Design and implement a study to determine minimum water levels and flow rates necessary for spring and fall spawning fish species in the St. Marys River and St. Marys Rapids - G

Concern: Exotic Species

Stakeholders and FMA' s identified sea lamprey control and movement and control of recently introduced harmful exotic species as critical issues in the St. Marys River. The SMRFTG recognizes the importance of continued sea lamprey control and assessment activities in the St. Marys River and has assigned high priority to these assessment projects. Surveillance and monitoring of other exotic species should also continue in the St. Marys River. The SMRFTG urges academia, and others to cooperate with FMAs to develop, propose, and implement future projects to evaluate naturalization of non-native fish species and effects of cormorants on existing fish populations.

Goal: Evaluate, monitor, understand, and control where necessary the introduction, spread, and impacts of exotic species in the St. Marys River.

Assessment Actions: (M= Management information need, G=general information need)

?? Continue sea lamprey assessment activities in the St. Marys River - M
?? Continue evaluation of sea lamprey control strategies - M
?? Continue monitoring and reporting wounding information - M
?? Enhance, standardize, and annualize ruffe and other exotic fish species assessments - M
?? Conduct fish harvest surveys to evaluate importance of non-native fish species to the St. Marys River Fishery (See Healthy Sustainable Fish Communities) - M
?? Design and implement studies to evaluate naturalization of non-native fish species in the St. Marys River - M & G
?? Design and implement future studies to evaluate cormorant diets and effects of predation on fish populations in the St. Marys River -G

Sea Lamprey Assessment –The SMRFTG considers current and future sea lamprey assessment in the St. Marys River to be a high priority. The Great Lakes Fishery Commission (GLFC) through its contracted agents, Fisheries and Oceans Canada, U.S. Fish and Wildlife Service, and U.S. Geological Survey should continue to conduct sea lamprey assessment activities annually on the St. Marys River. Assessment activities will primarily be used to evaluate the control strategy that was initiated in 1997. Agencies should also continue monitoring and reporting wounding information on sport, commercial, and assessment caught fish.

The GLFC control strategy consists of an integration of control technologies that includes short and long-term measures. The short-term measure was a 1998-1999 lampricide treatment with granular Bayluscide of 840 ha of the most densely populated larval sea lamprey habitat. The long-term measures include trapping and removal of spawning-phase sea lampreys from the river plus the sterilization and release of male lampreys trapped from the St. Marys and other Great Lakes tributaries. An assessment plan, available from the GLFC, proposes to integrate seven different assessment data sets that range

from measures of larval lamprey recruitment in the river to the survival of age 5+ lake trout in Lake Huron.

It is expected that the GLFC will continue to use a variety of indicators to measure effects of the control strategy. The main activities will include annual estimates of the parasitic sea lamprey population in northern Lake Huron including the North Channel, annual estimates of the St. Marys spawning run, annual estimates of the larval population in the river, and mark and recapture studies of transformers. The size of the parasitic population will be estimated by coded wire tagging of parasitic lamprey captured in the commercial and aboriginal fisheries and documentation of recaptures and untagged fish during the spawning run in the St. Marys River and other Lake Huron tributaries. The size of spawning run will be monitored with assessment traps fished at the Great Lake Power Corporation and USACOE powerhouses. The larval sea lamprey population will be estimated annually using an adaptive stratified sample design. It is expected that assessment efforts will be concentrated on areas of historically greater densities since it was determined that the variance was highest there. An adaptive sampling component will be used to increase precision in the estimate and to provide enough larvae to determine year class strength and biological data. Other density dependent responses to the control effort will be evaluated by collecting biological data including length, weight, sex and age on larvae, newly transformed and adult sea lampreys. Biological information will be collected from lamprey captured during larval and spawning assessments using fyke nets in the lower river from late October to early December.

Ruffe and Other Exotic Fish Species Assessment – The SMRFTG considers assessment and monitoring of ruffe and other exotic species to be extremely important in the St. Marys River. The St. Marys River is highly vulnerable to invasion by exotic species because it is a heavily used thoroughfare for international shipping. Release of exotic species through ballast water discharges is believed to be the principle means for recent invasions to the Great Lakes in recent years.

The U.S. Fish and Wildlife Service Ruffe Surveillance Program already includes the St. Marys River (Czypinski et al. 2000). Trawling and assessment locations within the river, however, should be standardized at strategic locations representing the various habitats throughout the river system. For ruffe, these habitats may include areas of turbid water with little light penetration, soft substrates, and depths ranging from three to eight meters (Czypinski et al. 2000). Specific locations might include estuaries, embayments, tributary mouths, shipping channels, and vessel ports (Czypinski et al. 2000). Collections made under the fish community survey will also assist in the monitoring of the colonization of exotic species.

Exotic Species Monitoring Methods used by the U.S. Fish & Wildlife Service -Bottom trawling gear, comprised of a 38-mm stretch mesh body, 31.8-mm stretch mesh cod end, and a 127-mm stretch mesh inner liner are deployed in April and early May each year to detect adult spawning phase ruffe. Trawling effort is standardized to 5-10 minute tows and tow speed is maintained at or below 1400 rpm (approximately 3.7 km/hr). Bottom water temperatures are recorded prior to each tow and trawling depths are recorded at the beginning and end of each tow. Surface temperatures and dissolved oxygen are recorded at all trawling locations and depths when possible. Additional gears may be utilized when trawling cannot be conducted. Pulsed DC electrofishing gear, 38-mm stretch mesh gillnets, 12.7 stretch

mesh seines, and experimental traps have been used in the past. If these gears are to be utilized, standard protocols should be developed for future use.

Evaluate Cormorant Diets and Effects of Predation – While not exotic, double-crested cormorants have been absent or in low numbers in the St. Marys River until their resurgence across North America beginning in the mid 1980s. Cormorants are included here, as they were generally regarded by stakeholders as a nuisance species. Although stakeholders expressed a desire to have cormorant eradication or control programs implemented immediately, FMA' s preferred to first identify the extent of cormorant impacts on fish communities and fisheries and defer to USFWS policy. Future assessments should be designed to evaluate seasonal diets and annual production of existing cormorant colonies in the St. Marys River. The SMRFTG recommends that academia and other cooperate with local FMA' s to develop and implement necessary studies to address cormorant concerns.

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Appendix 1. Acronyms used in this report

Acronym	Name/Title
AOC	Area of Concern
BMIC	Bay Mills Indian Community
CORA	Chippewa Ottawa Resource Authority
CPUE	Catch-Per-Unit-of-Effort
DFO	Fisheries and Oceans Canada
EEM	Environmental effects monitoring
EOs	Environmental Objectives
FCOs	Fish Community Objectives
FMAs	Fishery Management Agencies
GIS	Geographic Information System
GLFC	Great Lakes Fishery Commission
IJC	International Joint Commission
ITFAP	Inter Tribal Fisheries Assessment Program
LHC	Lake Huron Committee
LHTC	Lake Huron Technical Committee
LSSU	Lake Superior State University
LSSU-ARL	Lake Superior State University, Aquatic Research Lab
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Dept. of Natural Resources
MISA	Municipal industrial strategy for abatement
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
OMNR	Ontario Ministry of Natural Resources
OMOE	Ontario Ministry of the Environment
OTC	Oxytetracycline
RAP	Remedial Action Plan
SIRC	Spatial Information Resource Center
SMB	Smallmouth bass
SMRFTG	St. Marys River Fisheries Task Group
USACOE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United State Fish & Wildlife Service

Appendix 2. List of species mentioned in this plan.

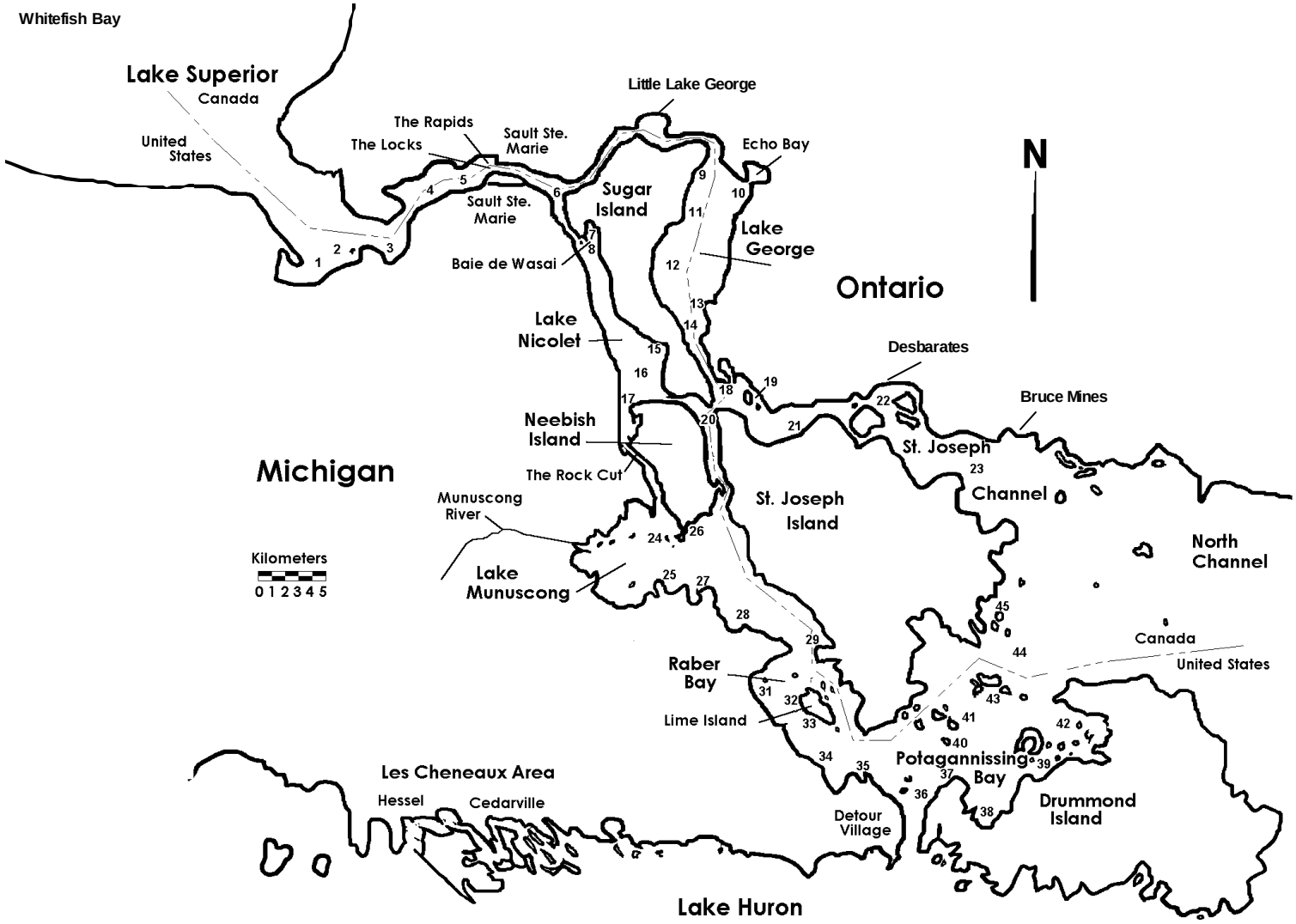
Common Name	Scientific Name
alewife	*Alosa pseudoharengus*
Brook trout	*Salvelinus fontinalis*
Chinook salmon	*Oncorhynchus tshawytscha*
chub	*Coregonus sp.*
coho salmon	*Oncorhynchus kisutch*
white sucker	*Catostomus commersoni*
deepwater cisco	*Coregonus johannae*
Johnny Darter	*Etheostoma nigrum*
lake herring	*Coregonus artedii*
lake sturgeon	*Acipenser fulvescens*
lake trout	*Salvelinus namaycush*
lake whitefish	*Coregonus clupeaformis*
mottled sculpin	*Cottus bairdi*
ninespine stickleback	*Pungitius pungitius*
northern pike	*Esox lucius*
pink salmon	*Oncorhynchus gorbuscha*
rainbow smelt	*Osmerus mordax*
rainbow trout	*Oncorhynchus mykiss*
round goby	*Neogobius melanostomus*
eurasian ruffe	*Gymnocephalus cernuus*
sea lamprey	*Petromyzon marinus*
slimy sculpin	*Cottus cognatus*
smallmouth bass	*Micropterus dolomieui*
splake	*Salvelinus fontinalis x Salvelinus namaycush*
spottail shiner	*Notropis hudsonius*
trout-perch	*Percopsis omiscomaycus*
walleye	*Stizostedion vitreum*
yellow perch	*Perca flavescens*
zebra mussels	*Dreissena polymorpha*
atlantic salmon	*Salmo salar*
muskellunge	*Esox masquinongy*
spiny water flea	*Bythotrephes cederstroemi*
double-crested cormorant	*Phalacrocorax auritus*
brown trout	*Salmo trutta*
pinook	*Oncorhynchus tshawytscha x Oncorhynchus gorbuscha*
tiger musky	*Esox lucius x Esox masquinongy*

Appendix 3. A summary of proposed surveys for the St. Marys River, organized by the concern they address, including frequency, timing, and information collected and probable participants.

Assessment	Frequency	Month(s)	Information gained	Responsible agency
Concern: Healthy Sustainable Fish Communities and Fisheries Supported by Sustainable Aquatic Food Webs				
Gillnet Survey	Annually Minimum of once every three years	Aug	Abundance and population characteristics of all fish species.	Joint survey between SMRFTG member agencies
Trawl Survey	Annually Minimum of once every three years	Aug	Abundance and population characteristics of juvenile & forage species.	Joint survey between SMRFTG member agencies
Seine Survey	Annually Minimum of once every three years	Aug	In place of or to supplement trawl survey if necessary.	Joint survey between SMRFTG member agencies
Electrofishing Survey	Annually Minimum of once every three years	Aug	To supplement gillnet survey if necessary	Joint survey between SMRFTG member agencies
Stocking Evaluation	Annual	On going	Survival and contribution of stocked fish. Understand sources of recruitment.	Joint effort between SMRFTG member agencies
Early Life History Sampling	As Needed	Spring	Understanding limitations to reproduction and recruitment. To be conducted when specific management questions arise.	Joint survey between SMRFTG member agencies
Fish Harvest Survey	Creel – Annually Subsistence and commercial reporting annually	Creel – May – Oct. & Jan. – Mar. Reporting in Apr.	Trends in fishing pressure, harvest, catch rate, and biological information.	Joint survey between SMRFTG member agencies
Tagging Studies	Annually Minimum of once every three years	Mar. – Apr.	Exploitation rate estimation, movement, mortality rate estimation.	Joint survey between SMRFTG member agencies
Macroinvertebrate and zooplankton Surveys	Annually Minimum of once every three years	August	Abundance and diversity of invertebrates. Also assist in the monitoring of exotic species.	Cooperative surveys between SMRFTG and outside agencies, universities, and experts.
Concern: Quantity and Quality of Aquatic Habitat to Support Fish Sustainable Fish Communities				
GIS Project	Annual	All	Geographic representation of habitat types, trends in abundance, relation to fisheries data sets.	MDNR creation, and then maintained by SMRFTG member agencies
Substrate Mapping and Flow Studies	Every 10 years	Summer	Inventory all substrate types and river flow in St. Marys River.	Cooperative surveys between SMRFTG and outside agencies, universities, and experts.
Habitat Inventory and Biological Monitoring	As needed	Summer	Inventory habitat types to fill-out habitat types in GIS database as information gaps are identified	Cooperative surveys SMRFTG and outside agencies, universities, and experts.

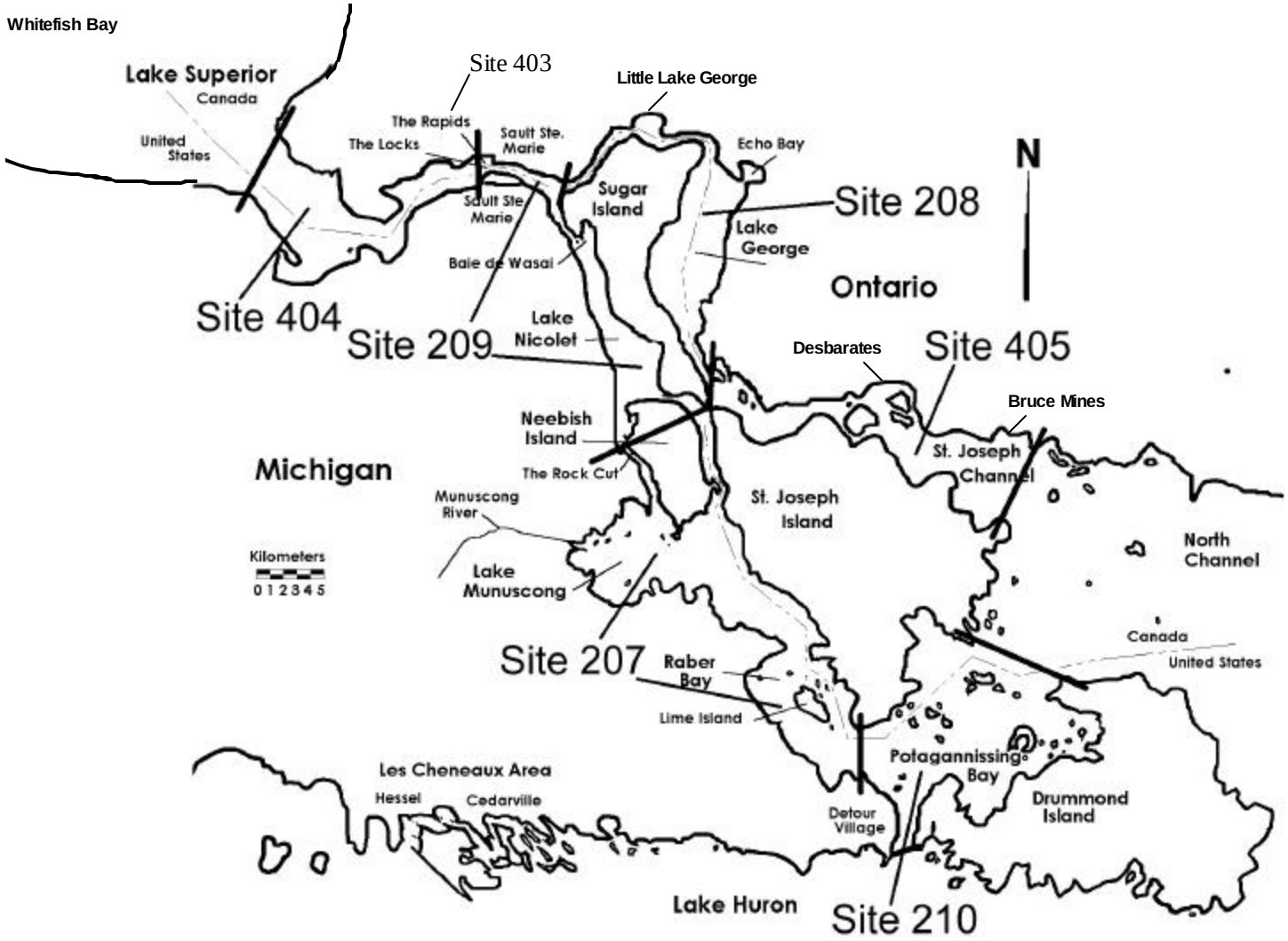
Concern: Water Chemistry and Water Quantity and Quality				
Assessment	**Frequency**	**Month(s)**	**Information gained**	**Responsible agency**
Water Quality Monitoring Program	Annual	Monthly	Whole River Water Quality Information	St. Marys RAP
Aerial Monitoring of Cannelton Industries site	Every 5 years	As needed	Data file and early warning for developing issues	St. Marys RAP
Monitor potential adverse effects to Aboriginal lands or water supplies	Every 5 years	As needed	Documentation of existing issues and progress in restoration	St. Marys RAP
St. Marys Paper Effluent Monitoring	Every 3 years	As Needed	Documentation of Improved Effluent Quality	St. Marys RAP
East End Water Pollution Control Plant Monitoring	As Needed	As Needed	Documentation of Concentrations and Loading of Persistent Contaminants.	St. Marys RAP
Monitor Surface Water, Groundwater Wetland Soils, and Biota at Cannelton Industries Site	As needed. Site Reviews every 5 years	As Needed	Monitor remediation efforts at Cannelton Industry Site	St. Marys RAP
Design Storm Water Monitoring System	As Needed	As Needed	Quality and Quantity of Storm Water Entering St. Marys River	St Marys RAP
Contaminated Sediment Survey	As needed then every 5 years	As Needed	Whole River Sediment Quality Information and Trends	St. Marys RAP
Benthic, Toxicity, and Sediment Studies in Bellevue Marine Park	Periodically	As Needed	Documentation of Water and Sediment Quality and Benthic Communities	St. Marys RAP
Sediment and Benthic Community Assessments at Algoma Steel	As Needed	As Needed	Determine Effectiveness of Contaminant Removal.	St. Marys RAP
Sediment Studies in High Priority Areas	As Needed	As Needed	Monitor Sediment Quality at High Priority Sites.	St. Marys RAP
Develop a GIS format to present & maintain results of above projects	Annual	As Needed	Ready reference to monitor trend through time progress in AOC	St. Marys RAP
Design and Implement Studies to Evaluate Water Levels in St. Marys River	As Needed	As Needed	Effects of Water Levels and Flow Rates on Spawning Fish and Fish Production in the St. Marys River and St. Marys Rapids	Cooperative surveys between SMRFTG and outside agencies, universities, and experts.
Design and Implement Studies to Determine Flows For Fishes in St. Marys Rapids	As Needed	As Needed	Documentation of Minimum Flow and Water Level Requirements For Fish Spawning and Survival in St. Marys River and St. Marys Rapids	Cooperative surveys between SMRFTG and outside agencies, universities, and experts.

Concern: Exotic Species				
Sea Lamprey Assessments	Annual	As Needed	Evaluate Control Strategies	GLFC and Control Agents
Evaluate Sea Lamprey Control Strategies	As Needed	As Needed	Refine control techniques and cost effectiveness of control	GLFC and Control Agents
Sea Lamprey Wounding Monitoring	Annual	As Needed	Evaluate Control Strategies, Parasitic Sea Lamprey Production, and fish mortality	Great Lakes Fishery Agencies and Governments
Ruffe and Other Exotic Species Surveillance	Annual	Summer	Monitor the invasion and spread of exotic species	USFWS
Assessment	**Frequency**	**Month(s)**	**Information gained**	**Responsible agency**
Evaluate Cormorant Diets and Effects of Predation	As Needed	Seasonal	Identify Extent of Cormorant Impacts on Fish Communities and Fisheries	Cooperative surveys SMRFTG and outside agencies, universities, and experts

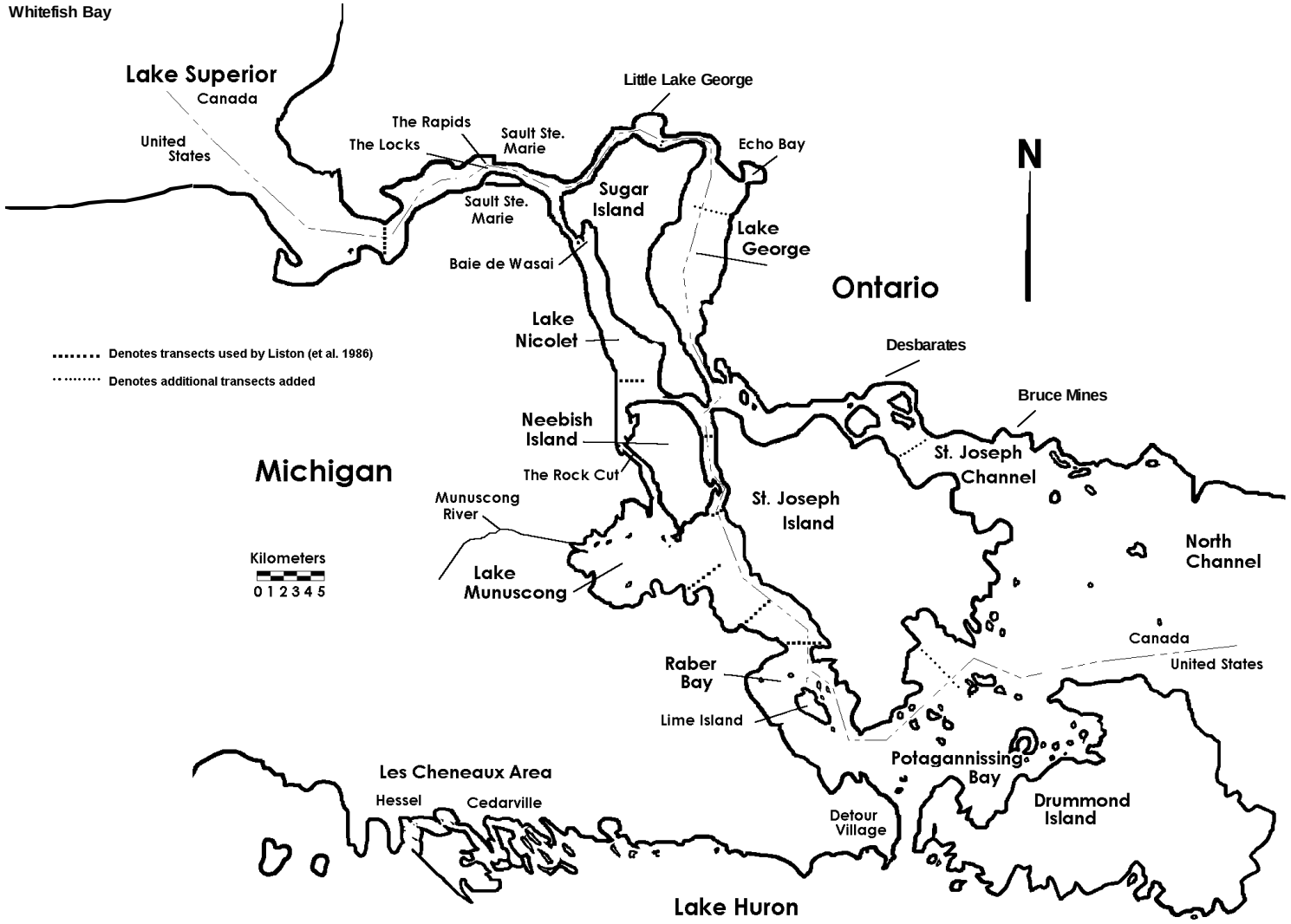


Appendix 4, Figure A. Fish community gil lnet survey locations in the St. Marys River.

Appendix 4, Figure B. Fish community trawling survey locations in the St. Marys River.



Appendix 4, Figure C. Creel survey sites, St. Marys River.



Appendix 4, Figure D. Transects for benthic macroinvertebrate and zooplankton sampling in the St. Marys River.