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Abstract.–In August 1995, St. Marys River was sampled with graded-mesh gill nets to determine status of the fish populations and to provide some comparisons to previous surveys (1975, 1979, and 1987). A total of 53 net sets were fished in both U.S. and Canada. An additional 36 sets were performed in April, May and June 1995. Results indicate the abundance of many species (as determined by gill net catch per unit of effort) has not changed appreciably from previous surveys. Abundance of most fishes was very similar to 1975 and 1979 levels, however, some species such as yellow perch were significantly more abundant in 1987. Smallmouth bass also had a significantly greater catch rate in the last two surveys compared to the first two. Growth was slow for most species compared to the state average, and is attributed to the short growing season and the cold, oligotrophic nature of the water. The exception was lake herring, which grew better than state average. Measurements of condition were average for most species and areas. Mortality of certain key species such as walleye, northern pike, lake herring, and yellow perch (for southern portions of the river) was found to be high. Despite the stable nature of fish abundance in the river, long term angler dissatisfaction has been noted and declines in the fishery have been documented between 1987 and 1991 (the only two years surveyed). Some possible reasons include apportionment of the harvestable surplus among large numbers of users and multiple, competing fisheries such as a commercial fishery in the Canadian waters of Potagannissing Bay, tribal subsistence fisheries, intensive sport fisheries and possibly by cormorant predation. Management recommendations include the joint determination of maximum acceptable mortality levels for key game species and the apportionment of harvest among the various fisheries (sport, subsistence and commercial).

A substantial sport fishery exists in St. Marys River. Rakoczy (1992) estimated that roughly 600,000 angler hours were spent fishing this river during 1987. This was equivalent to 25% of Michigan's entire Lake Huron sport fishing effort. We estimate that 10.5 million dollars in economic activity was generated that year as a result of sport fishing [based on 161,879 angler trips (Rakoczy 1992) and $65/trip expenditure (U.S. Department of Interior 1993)]. Since 1991, when the sport fishery was last surveyed, Michigan Department of Natural Resources (MDNR) Fisheries Division has received many angler complaints about poor fishing in the river. The 1987 (Rakoczy and Rogers 1988) and 1991 fishery statistics add substance to the complaints with total angler effort declining by 20%. Yellow perch (see Appendix 1 for a complete listing of common and scientific names of fishes mentioned in this report) harvest declined by 71% and catch rate by 64% from 1987 to 1991. In addition, lake herring harvest declined by 90% and catch rate by 87%.

The purpose of this study was to provide information on abundance, growth, mortality, size structure of the fish populations in 1995 and to make comparisons to previous surveys (Schorfhaar 1975; Miller 1981; Grimm 1989). Further, it was the objective of this report to provide some explanation for the aforementioned declines and offer recommendations for management.

Study Site

St. Marys River is a former strait connecting Lake Superior and Lake Huron. It originates in Whitefish Bay, Lake Superior, and flows southeasterly about 112 km to empty into Lake Huron at Detour Village. The river is bounded on the west and south by Chippewa County, Michigan and on the north and east by Ontario. Michigan waters of the river total about 50,588 ha. This water body is a very complex system. Between the Rapids and Detour Village, the river contains four distinct lacustrine ecosystems: Lake Nicolet, Lake George, Lake Munuscong, and Raber Bay (Figure 1). Connecting the lakes are riverine channels of deep water and substantial current velocity. Potagannissing Bay, although technically separate from the actual river and open to the North Channel of Lake Huron, is also included in this study because of its intimate connection and ecological importance.

The Rapids at Sault Ste. Marie is a unique segment of the river. Here, within a distance of 1.2 km, the river drops 6.1 m, producing a substrate of large (>1m) boulders on bedrock (Duffy et al 1987). Archeological studies have documented the 2,000-year-old presence on Whitefish Island of a permanent Native American village, possibly as large as several thousand inhabitants. Bayliss and Bayliss (1955) recounted early commentary from French explorers describing a dip net fishery in which netters could boat several hundred lake whitefish, averaging 4-6 kg each in an hour. The Rapids are now but a remnant of what they once were, due mostly to physical encroachment of the Soo Locks. There has been a diversion of about 93% of the total river flow from the rapids for hydroelectric generation (Edsall and Gannon 1993). Despite the altered state, the remaining rapids provide almost year-round angling for salmon and trout.

Methods

This study was conducted jointly by MDNR (Alpena Great Lakes Fisheries Research Station and District Four), fisheries personnel from Bay Mills Indian Community (Brimley, MI) and the Ontario Ministry of Natural Resources (Sault Ste. Marie office). The survey utilized graded-mesh multi-filament nylon gill nets, 152 m (500 ft) long and 1.8 m (6 ft) deep. Each net was comprised of 30 m (100 ft) panels of 38.1, 50.8, 63.5, 76.2, and 114.3 mm (1.5, 2.0, 2.5, 3.0, and 4.5 in.) stretch mesh. Gill nets were fished overnight on the bottom. These nets contained the same mesh sizes as previous MDNR surveys of St. Marys River (1975, 1979 and 1987) except for the addition of 38 mm mesh. The survey took place in August to allow comparisons to previous surveys.

Abundance was expressed on the basis of the number of fish caught per 305 m (1000 ft) of gill net per night (Catch per unit of effort or CPUE) to allow comparisons to previous surveys. Calculations of CPUE excluded catch of the 38.1 mm mesh so as to allow for a more direct comparison to previous surveys. Because catch was not recorded by mesh size in some areas, calculations of CPUE in Potagannissing Bay and Raber Bay (Figure 1) included the 38.1 mm mesh. Those calculations of CPUE are still based on 305 m of effort but do include fishes taken in the smaller mesh size. A total of 53 gill net sets were fished in August 1995 at the 53 sites depicted in Figure 1.

All lake herring, walleye, northern pike, yellow perch and smallmouth bass (henceforth grouped as target species) were measured for total length (mm) and weight (g). Scales were collected for age analysis. Average length at age was calculated and referenced to State of Michigan averages (Merna et al 1981) and to averages reported from previous surveys. Growth index is the summation of mean differences between average length at age and the state average, divided by the number of age groups represented by five or more specimens. In addition, specimens were scored for lamprey wounds and marks scored according to King and Edsall (1979). Results were summarized as either ìfreshî (type A, Stage 1) or ìscarî. Specimens of target species were also inspected for stomach contents and scored for maturity, and lake herring were scored for visceral fat according to Goede (1989). Specimens of all other species were measured for total length and weight only.

Stomach contents of target species are reported as incidence (percent void and percent with contents) and as percent occurrence. Percent occurrence is the percent of nonvoid stomachs containing at least one of a particular prey item. Also included is the percent each prey type comprised of all items eaten.

In addition to the August survey, three areas of the river were sampled with gill nets in April, May and June 1995. This sampling took place with overnight bottom sets of 38.1 and 50.8 mm stretch-measure gill nets comprised of multi-filament nylon. Nets were constructed of panels of each mesh measuring 30.5 m long by 1.8 m deep for a total of 61 m per net. Four such overnight sets were made during each month in three areas: Baie de Waisi (Lake Nicolet), below the Rock Cut, and in Lake Munuscong (Figure 1). This netting was conducted to determine usage of the river during spawning migrations by non-native planktivores such as alewife and rainbow smelt. Catch per unit of effort was calculated and expressed per 61 m of net per night.

Total annual mortality estimates for target species were computed using a program based upon the Robson-Chapman catch curve mortality method (Robson and Chapman 1961).

Condition of target species from the August portion of the survey was expressed as average relative weight (Wr) (Anderson and Neumann 1996) except for lake herring which lack a standard weight formula. Condition of lake herring was calculated as average relative condition factor (Kn) (Le Cren 1951) and as average visceral fat index (Goede 1989). Relative weight pertains to a standard for a species based on a standard weight equation (Anderson and Neumann 1996). Length-weight regression equations were calculated for target species. Length distributions of target species were expressed as proportional stock density (PSD) and relative stock density (RSD) (Ney 1993) and referenced with recommended ranges for exploited populations (Anderson and Neumann 1996). Length-weight equations, PSD and RSD are provided partly as baseline information for future studies.

Differences in survey mean CPUE, Wr, and Kn were evaluated with analysis of variance or by Kruskal-Wallis non-parametric tests (Neter et al 1985). Significant differences among specific means were determined by Scheffe multiple comparison procedure (Neter et al 1985). Comparison of some survey means to previous years were not possible due to the absence of raw data. Simple linear regression was used to describe the length-weight relationship for the target species. All statistical tests were performed at $P_{\alpha} \leq 0.05$.

Results

Twenty four fish species were collected by gill net during August 1995 (Table 1). The 1995 survey collected Atlantic salmon and northern hog sucker for the first time. Absent from the catch in 1995 were lake sturgeon, bowfin and rainbow trout. Yellow perch, northern pike and walleye were present in all areas of the river (Table 2). Smallmouth bass were found in all but the upper river (area upstream from Lake Nicolet) and lake herring were found in all areas except the upper river and Lake Munuscong. Other species of notable abundance were rock bass, alewife, white and longnose suckers and brown bullhead.

The supplemental spring netting with small mesh nets detected no rainbow smelt, while alewife were absent until June (Table 3). Lake herring were collected throughout this time period in all areas. Alewife were collected in all areas except Lake Munuscong during the August survey. The greatest alewife concentration was in Potagannissing Bay. Rainbow smelt were collected in August in all areas except the upper river and Lake Nicolet.

Walleye

Abundance of walleye, as indicated by gill net CPUE, was not significantly different between years (Table 1, Figure 2). Similarly, no significant difference was detected in mean CPUE when examined by area (Table 2), although walleye appear to be increasing in more recent years in upstream reaches of the river. Abundance appears remarkably stable in other areas compared to previous surveys. Annual mortality of walleye was estimated to be 51% in 1995 (Table 4). Insufficient numbers were collected to calculate mortality by area. No previous surveys reported mortality so comparisons among years were not possible.

Because only small numbers of walleye were collected in any one geographic area, little can be said regarding trends in growth by area (Table 5) except for Potagannissing Bay. In that area, length at age has steadily declined since 1979 for walleye ages 2 through 4. When compared on a river wide basis, walleye growth is well below state average. Despite slow growth of walleye in St. Marys River, condition, as indicated by mean Wr, is average except in the Lake Munuscong area (Table 6). Relative weight by size class (Table 7) indicates that the strong mean Wr is supported primarily by the stock-size (250-380 mm) segment of the population.

Age frequency distributions indicate a declining mean age when compared to previous surveys (Table 5). Statistical significance could not be tested. Size structure of the walleye population appears balanced but at the upper limits of the recommended PSD range (Table 8 and Figure 3). This was probably caused primarily by gear selectivity, a lack of smaller walleye in the gill net catch. Given the slow growth of walleye in St. Marys River, age 1 and age 2 fish may not have been fully recruited to the gear. Of the walleye collected, 43.5% were of legal size [$\geq$ 381 mm (15 in.)].

Analysis of stomach contents during August indicate that rainbow smelt and alewife were the most frequent food items (Table 9). Walleye were not the target of many lamprey attacks (Table 10). A length-weight regression equation for walleye is presented in Appendix 2.

Northern Pike

Like walleye, this species has experienced no significant change in abundance on a river wide basis since 1975 (Table 1 and Figure 2). When examined by area (Table 2), only Potagannissing Bay experienced a significant decline. Annual mortality for northern pike was estimated at 58% for the whole river (Table 4). Growth of northern pike, as indicated by mean length at age, improved in most areas of the river in 1995 compared to previous surveys (Table 11) although statistical significance could not be tested. Despite this apparent improvement, growth of northern pike remained well below the state average (Table 11).

Condition of northern pike was average in all areas of the river (Table 6) and was consistent across size groups (Table 7). The sample was dominated by smaller individuals with only 1% of the fish greater than the stock size achieving preferred size (Table 8 and Figure 3). Of the northern pike collected, only 9.8% were of legal size [$\geq$610 mm (24 in.)]. Food habits of northern pike at the time of the August survey indicated utilization of a variety of species (Table 9). Ninespine stickleback and rainbow smelt were the most frequent prey items in the diet of northern pike. Northern pike were infrequently targeted by lamprey for attack (Table 10). The length - weight relationship for northern pike is described in Appendix 2.

Yellow Perch

Abundance of yellow perch in 1987 was significantly greater than in 1975, 1979 and 1995

(Table 1, Figure 2). No significant trend in abundance among years was evident by area (Table 2). Catch of yellow perch was sufficient to allow estimates by area of mortality rates. Annual mortality steadily increased from the upper reaches of the river (25%) to the lower reaches, 60% (Table 4). River wide, total annual mortality was just 38%.

Growth of yellow perch was generally stable among survey years and was approximately equal to or slightly above the state average (Table 12). Average age was stable in most locations except in Potagannissing Bay, where it was considerably lower than 1987 values. Relative weight of yellow perch was average throughout the river but significantly lower in Potagannissing Bay (Table 6). Relative weight was average across all size classes (Table 7). The size structure of the yellow perch population appears balanced with 3% of perch greater than stock size achieving memorable size (Table 8 and Figure 3). Fifty five percent of the yellow perch catch was of legal size [≥178 mm (7 in.)] but only 39% were legal in Potagannissing Bay.

Food habits of yellow perch included a large variety of prey items (Table 9). Crayfish were the most frequent food item eaten in August. Unidentified fish and other invertebrates (aquatic insects) comprised the next most frequently consumed categories. Slimy sculpin, plankton and mayfly comprised the majority of the remainder. There was no evidence of lamprey attacks on yellow perch (Table 10). The length-weight regression equation is presented in Appendix 2.

Lake Herring

The abundance of lake herring, was not significantly different among survey years despite a drop in CPUE of almost 50% since 1987 (Table 1, Figure 2). An examination of the lake herring catch among years indicated no statistically significant trends by area (Table 2). Lake herring mortality was much higher in Potagannissing Bay (55%) compared to the overall population less Potagannissing Bay (30%) (Table 4).

Growth of lake herring was excellent throughout the river and ranged well above state average in 1995 (Table 13). Condition, as indicated by relative condition factor and mean visceral fat index, appeared good throughout the river (Table 6).

Examination of stomach contents indicated that in August, food item frequency were almost entirely plankton (Table 9). Lamprey scarring was more prevalent in lake herring than other species examined (Table 10). The length - weight relationship is described for lake herring in Appendix 2.

Smallmouth Bass

The abundance of smallmouth bass was significantly greater in 1995 and 1987 surveys compared to 1979 (Table 1, Figure 2). An examination of CPUE among years by area indicated that increases in smallmouth bass abundance was significant greater in 1987 and 1995 compared as far back as 1975 for some areas (Table 2). Mortality of smallmouth bass was relatively low (36%; Table 4). Length at age for 1995 was much below the state average (Table 14). Despite slow growth, condition was good throughout the river (Table 6) and across all size ranges (Table 7). Size structure of the smallmouth bass population indicated a large proportion of individuals in the preferred size range (Table 8, Figure 3). Of the smallmouth bass collected, 22.7% were of legal size [≥356 mm (14 in.)].

The majority of the smallmouth bass diet during August was crayfish and other invertebrates (Table 9). No scarring by lamprey was evident (Table 10). The length-weight relationship is described in Appendix 2.

Discussion

The results of this survey indicate a fish community that with, few exceptions, is largely stable in its abundance. The fish populations of St. Marys River typically are slow growing with average condition. Mortality varies by species but is high for some species or in some reaches of the river.

Abundance for several species (walleye, northern pike, yellow perch and smallmouth bass) was much higher in 1987 than in the other three survey years. However, the difference was statistically significant only for yellow perch. It is unclear why 1987 produced better catch rates for those species. In many instances, the greater catch rates were driven primarily by higher CPUEs from Lake George (Table 2). This may have been a sampling artifact or 1987 may have had genuinely larger fish populations. Sport fishery catch rates in 1987 did exceed those of 1991 (the only other year surveyed). Regardless, it appears that long term average abundance levels may be better represented by the other three survey years. Angler's dissatisfaction with fishing may be partly in response to comparison to the better fishing experienced in 1987. Smallmouth bass were the only other game species to exhibit a statistically significant difference in CPUE among years. This species appears to be increasing in abundance since the 1970s.

Growth of many species in St. Marys River in 1995 was below state average. This may be due, in part, to a shorter growing season compared to much of the rest of the state and to the low temperature and nutrient characteristics of the Lake Superior waters flowing into the river. Growth was slow for the piscine predators examined (walleye and northern pike) and for species preying on both fish and invertebrates (smallmouth bass).

Growth was only at, or above state average for lake herring and yellow perch. Lake herring are primarily planktivores and the yellow perch were relying largely on invertebrates. Despite poor growth of many species, condition was average in most areas. This suggests that limitations to growth are not based on any density dependent mechanism. Food availability may change seasonally or even within the summer. This could also account for average condition in the face of poor growth.

In August, the majority of lake herring were found in the lower reaches of the river presumably because of the deeper water (Duffy et al 1987). This hypothesis is supported by lake herring CPUE which has always been greater in Raber Bay and Potagannissing Bay (Table 2). Lake Nicolet also held lake herring in August 1995.

The good growth exhibited by St. Marys River lake herring is partial testimony to the quality of habitat available to them. Liston et al (1986) could find no published accounts of growth rates faster than those exhibited by lake herring in St. Marys River. St. Marys River may provide a more productive environment than Lake Superior. Fast growth rates can also suggest that a population is below carrying capacity or possibly recruitment limited (Van Den Avyle 1993). Liston et al (1986) characterized St. Marys River as highly suitable spawning and nursery habitat for lake herring. There has been considerable concern, however, about the effects of winter navigation on the hatching success of herring (Liston 1986, Savino et al 1994). This is the subject of two studies being currently conducted by the MDNR and the Great Lakes Science Center, U.S. Geological Survey.

Mortality rates for some target species were high. Total annual mortality for walleye was 51%. Total annual mortality rates for walleye commonly range between 40 and 55 percent (Colby et al 1979). By comparison, other well known walleye fisheries in Michigan waters of the Great Lakes have much lower mortality levels. They include; Lake Erie at 36% annual mortality (Thomas and Haas 1996), Little Bay de Noc at 39% (Schneeberger 1996) and Saginaw Bay at 32% (Johnson et al 1996). Assuming there is no unusually high natural mortality rate, one might describe the population as heavily exploited. Previously, a target level of walleye mortality of 40% was set for St. Marys River in the draft plan for the management of Michigan's Lake Huron fishery (Johnson 1990). Although walleye abundance was unchanged since 1975, the population may have been equally exploited then. Angler dissatisfaction dates back to 1937 (Westerman and Van Oosten 1937).

Observations of age at maturity for walleye in St. Marys River suggest that females reach maturity between age four and five. Given the low frequency of fish older than age 5 (7.5% of the population; Table 5) the walleye population may be brood-stock limited. Similar analyses on other notable Michigan walleye populations reveal higher proportions of mature females;

Saginaw Bay at 17%, Little Bay de Noc at 36%, and Lake Erie at 19%.

Total annual mortality rates of yellow perch may also be high in Potagannissing Bay (60%). Lucchesi (1988) documented total annual mortality rates of yellow perch in Les Cheneaux Islands area of Lake Huron at 55% and characterized it as a rate resultant of an intensive sport fishery. Mortality may vary considerably among various sections of the river for all species. This may be caused by uneven sport fishing pressure. For example, in 1987, Lake George, which had produced substantially greater net CPUEs, only accounted for 7.4% of the river's fishing pressure (Rakoczy and Rogers 1988). In both 1987 and 1991 creel surveys, the lower 1/3 of the river system accounted for 58%-60% of the fishing pressure (Rakoczy 1992). The mortality pattern of yellow perch in 1995 likewise was low up-river (25%) and increased downstream to Potagannissing Bay (Table 4).

Northern pike total mortality was 58% in 1995 (Table 4). As with walleye, this rate may serve to compromise the quality of the fishery. The northern pike PSD of 31 is at the lower limits of those recommended for the size structure of a northern pike population. A minimum length limit of 610 mm (24 inches) was recently implemented state wide in Michigan but will likely have little benefit in St. Marys River in the absence of any similar regulation for the competing fisheries.

The sport fishery in Michigan and Ontario waters of the river is very substantial. Fishing pressure ranges from 8.4 hrs/ha (1991) to 10.5 hrs/ha (1987) (Rakoczy and Rogers 1988; Rakoczy 1992). These fishing pressures (which include Canadian waters) are greater than the sport fishery in Saginaw Bay (4.3 to 6.4 hrs/ha) and as high as Michigan's waters of Lake Erie in some years (10.7 hrs/ha: 1991). Total harvest of game species also confirms that the sport fishery produces a substantial component of the total annual mortality rate for fish.

Miller (1981) observed few walleyes over 38.1 cm (15 in) in Lake George, Munuscong Bay and Raber Bay and concluded that the population size structure was affected by heavy harvest. Age structure (Table 5) suggests few walleyes are surviving past age 5. The high PSD and RSD for walleye (Table 8, Figure 3) was partly an artifact of low catches of stock size fish.

Sport harvest of lake herring in Michigan waters of St. Marys River was deemed excessive in 1987 when 141,000 were harvested (Rakoczy and Rogers 1988; Grimm 1989). That year many anglers and local residents complained about witnessing wanton waste of fish (Grimm 1989). This led to the imposition of a creel limit of 12 lake herring by MDNR (Grimm 1989). A reduction of mortality rate was not the objective of this regulation change (J. Schrouder, MDNR, personal communication). Total annual mortality for lake herring in Potagannissing Bay was 57% in 1987 (Grimm 1989). In 1995, it was 55% suggesting that survival has not been affected (Table 4). This may be in part due to a lack of any sport creel limit for lake herring in Canadian waters of the St. Marys River. Some anglers reported using the different harvest regulations between Ontario and Michigan to exceed the daily limit of 12 lake herring by securing sport licenses from both locations. Sue Greenwood (OMNR, personal communication) reports that Ontario has also experienced excessive sport harvest of lake herring and is considering imposing a creel limit.

Besides the sport fishery, there may be several other key sources of mortality in St. Marys River and Potagannissing Bay. A commercial fishery exists in much of the Canadian waters of Potagannissing Bay and the mouth of the St. Joseph Channel. The fishery has used both trap nets and gill nets but has evolved to almost entirely gill nets in recent years (Mohr and Gile 1996). Walleye are the principle target of the fishery and annual walleye harvest averaged 6,873 kg in 1991 to 1995 (Table 15).

It is not entirely clear the degree to which the commercial fishery is exploiting St. Marys River walleye stocks. Liston et al (1986) documented post-spawning migrations of walleye from the Munuscong River as far away as Potagannissing Bay. Clearly, Potagannissing Bay populations have the greatest potential for impact from the effects of the commercial fishery.

Another source of mortality is the Native American subsistence fishery. This fishery primarily uses gill nets while other gears are permitted including hook and line and spearing (Liston et al 1986). Gill nets are limited to 30.5m (100 ft) in length and possession of fish limited to 45 kg (100 lb). Harvested fish are intended for personal consumption only. Mesh sizes as small as 63.5 mm (2.5 in) are allowed. Participation in the fishery is controlled by the Chippewa/Ottawa Treaty Fishery Management Authority (COTFMA), and limited voluntary records are kept on the amount or species harvested. Liston et al (1986) reported most game species are subject to harvest and characterized the number taken in 1981 and 1982 as modest. Most harvest occurs, but is not limited to, the area from Lake Munuscong upstream. A total of 144 kg of various species were reported harvested in 1995 (Table 16). This is a minimum estimate and reflects only those taken from gill nets. Harvest via sport methods is thought to be substantial at times (Mark Ebener, COTFMA, personal communication).

Subsistence fishing in Ontario waters is conducted by members of Garden River First Nation in the Garden River, Little Lake George and Lake George areas. Walleye is a target species. Presently the OMNR and Garden River First Nation are using litigation to resolve exploitation of this fishery. Fishing in open water is by gill net. Spearing on spawning beds has been conducted and is the primary issue before the courts (Sue Greenwood, OMNR, personal communication).

Still another source of fish mortality in recent years is avian predation by cormorants. Many local anglers have reported that increasing numbers of cormorants are fishing the waters of St. Marys River, particularly Potagannissing Bay. A research study in the Les Cheneaux Islands area of northern Lake Huron indicates that cormorants prey predominantly on alewife but also on yellow perch during certain times of the year (Diana et al 1997).

These various sources of mortality (including the United States and Canadian sport fisheries) are all exerting their effects on the fish populations in the river. While any one source may not be individually substantial, collectively, total annual mortality may prove excessive for some species in some areas. Unfortunately, many of these sources are beyond the control of the Fisheries Division of MDNR. The Canadian sport and commercial fishery and tribal subsistence fisheries fall outside the regulatory authority of this agency. Native American fishing rights have been established by treaty and upheld in federal courts. Control of cormorants is also outside the jurisdiction of the states. As a migratory waterfowl, cormorants falls under the authority of the U.S. Fish and Wildlife Service and Canadian Wildlife Service. Currently there is no hunting season for cormorants.

The state's influence over mortality sources in St. Marys River is limited to sport harvest regulations in the Michigan waters. More restrictive harvest regulations by all agencies may be a means by which to reduce mortality. The absence of recent and regular creel surveys in St. Marys River make the design of new length limits or reductions in creel limits more difficult. Current harvest restrictions in the Michigan sport fishery are ineffective when there are more liberal regulations in other fisheries.

The invasion of the Great Lakes by non-native planktivores such as alewife and rainbow smelt have been well documented to precipitate decline of certain native species via competition (Wells 1970; Crowder et al 1987) and direct predation on larvae or eggs (Kohler and Ney 1980; Wells 1980; Brandt et al 1987). Liston et al (1986) speculated that alewife from Lake Huron use the river during certain times of the year, including for spawning. Alewife were encountered in each of the survey years since 1975 (Table 1) but catch greatly increased in 1995. This increase was probably due primarily to the use of 38.1 mm mesh in the lower river. Alewife were not found in abundance in the north and central portions of the river during spring and early summer (Table 3). The presence of increased alewife catch in June and later in August supports the contention of Liston et al (1986) that alewife migrate from Lake Huron. In addition, alewife were found in the diets of walleye, lake herring, northern pike and yellow perch in August. The seasonal usage of portions of the river by alewife may have some impact on recruitment of some species including walleye and yellow perch.

Walleye stocking performed by MDNR in the past in St. Marys River has utilized brood stock from Little Bay de Noc in northern Lake Michigan. Billington et al (1992) examined mitochondrial DNA variation in walleye stocks and the potential effects from transfers between drainage basins. The risks include poor survival of stocked fish and an overall reduction in the population's fitness. Billington (et al 1992) concluded by cautioning against transfers between drainage basins.

Miller (1981) discussed angler complaints about the river fishery. Although anglers felt the sport fishery was declining through the late 1970s, little change was observed in population density or age structure between 1975 and 1979 surveys for most species. Fishing was quite good during 1987, and survey results from that year verified an increase in fish numbers. Even so, comparison of all four surveys indicate that the fish community has been quite constant during the past 20 years. Declines in resort clientele may therefore be partly a result of changes in social and economic attitudes rather than the fishery itself. Further, declines perceived by anglers may result from reallocation of the fishery among more anglers. Without frequent creel surveys, however, it is difficult to verify trends in angler participation and fishing pressure.

Few salmon and trout were sampled during August 1995 (Table 1). This is despite considerable stocking of salmonids in St. Marys River since 1982 (Table 17). These stockings may make contributions to the open water fishery of Lake Huron or to the river during spawning migrations. The Rapids area may harbor salmonids during the summer, however, it was outside the study area. Anglers fishing in locations other than the Rapids were questioned in the 1991 creel survey (Rakoczy 1992) as to their target species. Of those, 41.6% responded they were targeting salmon or trout species (MDNR, unpublished data), while these species comprise only 8.3% of the non-rapids sport harvest through October. Walleye and yellow perch comprised 29.5% of the targeted effort and northern pike 10.5%. Lake herring and smallmouth bass each were 2.5%. Coolwater species together comprised 76% of the open water harvest.

Management Recommendations

(1) Fundamental and critical to the successful management of the sport fisheries of St. Marys River is the regular assessment of harvest, fishing pressure, catch rates and other parameters of the fishery via a creel survey. The sport fishery of St. Marys River has accounted for as much as 25% of Michiganís Lake Huron fishery but has been surveyed by MDNR only twice (1987 and 1991). While there have been other smaller surveys conducted intermittently including the Rapids area, this level of effort is wholly inadequate. The sport fishery of the river should be surveyed for at least two consecutive years three times every decade. Efforts should be made to coordinate the survey with the OMNR to include Canadian waters (including the Rapids) providing a more holistic assessment.

(2) The fish populations of St. Marys River should be surveyed according to the methods of this report at least every other year. This basic information on the biological parameters of these fish populations is essential to effective management of the sport fishery. These surveys, in concert with regular creel surveys, will provide the information necessary to both evaluate management practices and develop new ones.

(3) Maximum acceptable mortality levels for key sport and commercial species should be agreed upon by various fishery management agencies (COTFMA, OMNR, and MDNR). Included in this consensus should be a mutually agreed upon means to regularly monitor mortality, perhaps via tagging studies. Based on an agreed upon maximum acceptable mortality level, regulations should be designed and implemented to apportion harvest of St. Marys River stocks among the various interests.

(4) MDNR should continue to stock walleye fingerlings in St. Marys River and Potagannissing Bay. The stocking should be evaluated by marking or alternate year stocking and coordinated in a uniform

fashion the length of the river. MDNR should also consider beginning walleye spawn collection efforts from the St. Marys River. Such an effort will help ensure the preservation of any unique genetic characteristics of the stock until they can be formally evaluated. Walleye fingerling plants should be moved or expanded from the Sault Ste. Marie vicinity to Lake Nicolet where more desirable nursery habitat exists.

(5) Given the small amount of salmon and trout harvested between April and October in the U.S. waters of the river, the salmonid stocking effort by the MDNR should be reevaluated. These fish may make contributions to the Lake Huron fishery, but smolt survival may be minimal given the presence of coolwater predators in the river. The objectives of salmonid stocking performed by the MDNR in the St. Marys River should be reviewed.

(6) MDNR, the U. S. Army Corps of Engineers and U. S. Coast Guard should continue to work together to evaluate the effects of navigation and minimization of its impacts.

(7) An information and education program should be begun to inform the angling public and others of the findings and recommendations of this report with the objectives of helping the public to understand limitations of the St. Marys River sport fishery and to shape expectations.

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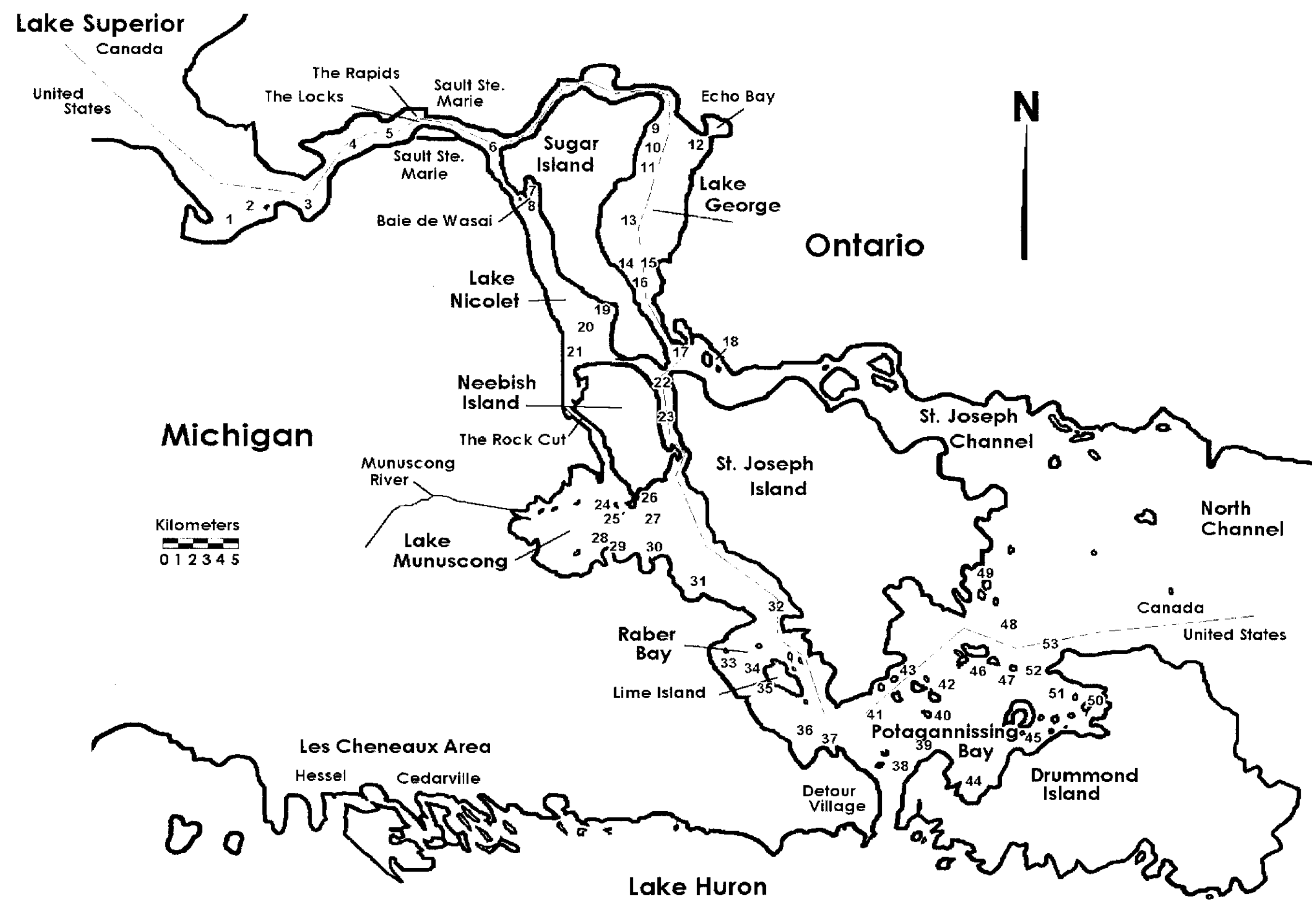

Figure 1.–Map of the St. Marys River system, showing August 1995 netting locations.

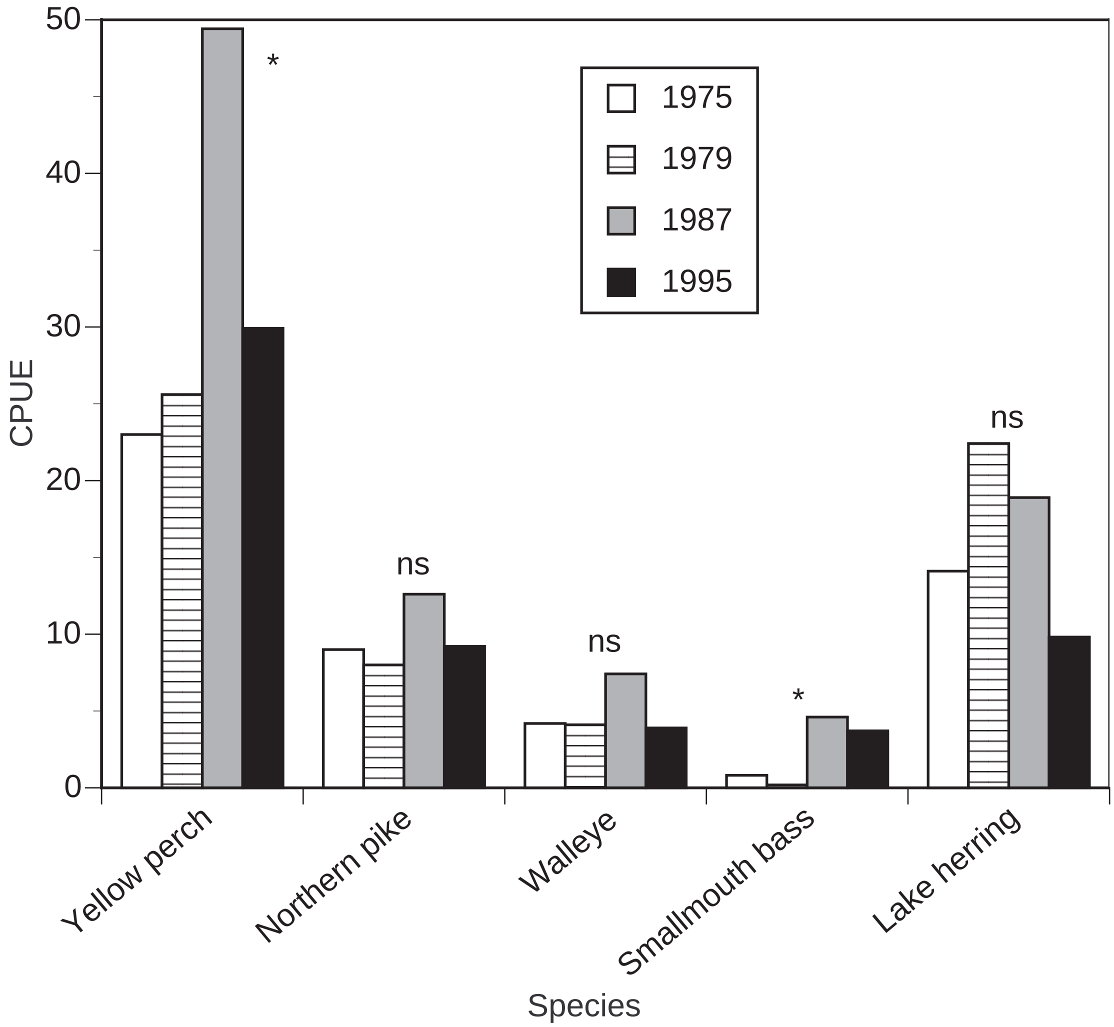

Figure 2.–Trends in abundance, as indicated by gill net CPUE, of target species from the St. Marys River for 1975, 1979, 1987, and 1995. ns = no significant difference among years, * = significant difference (P <0.05).

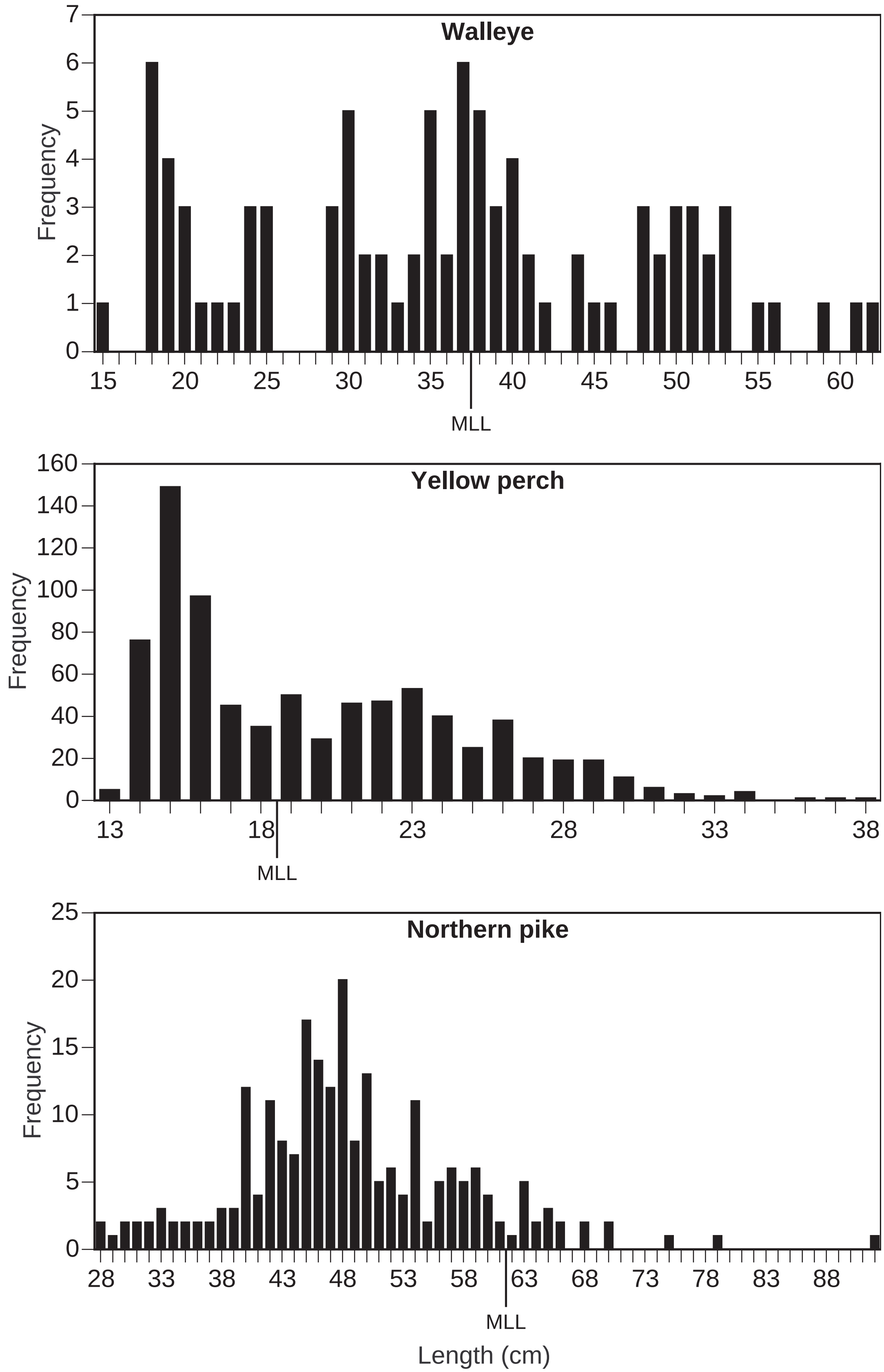

Figure 3.–Length frequencies of select species from the St. Marys River, August 1995. MLL denotes minimum length limit for Michigan's sport fishery.

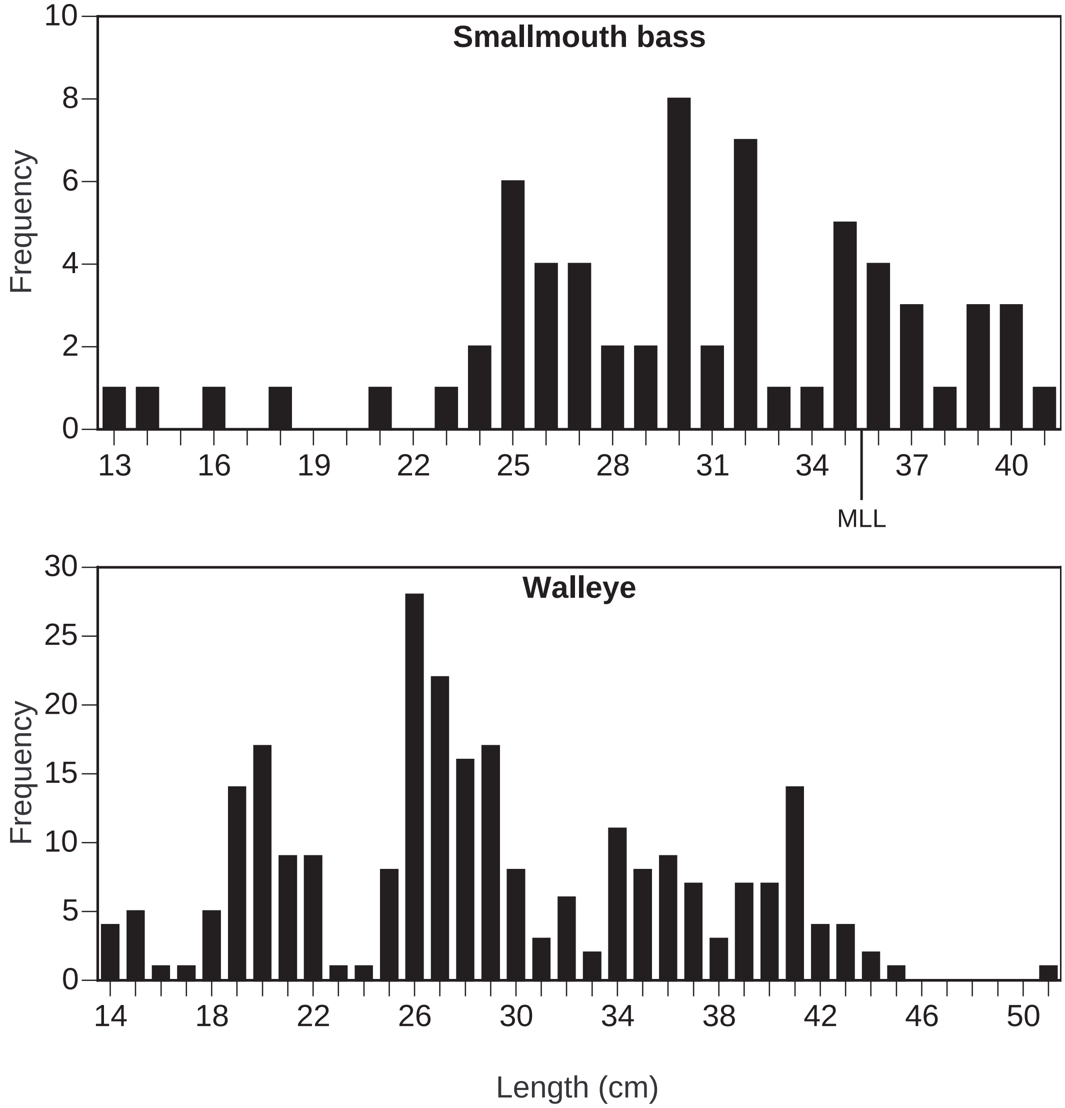

Figure 3.–Continued.

Table 1.–Mean (SE) CPUE of all species collected from St. Marys River 1975 to 1995. Means for target species with no letters in common are significantly different between years.

Species	1975 (N=32)		1979 (N=32)		1987 (N=27)		1995 (N=51)	
Alewife	1.64	(0.57)	0.23	(0.12)	0.19	(0.11)	15.11	(12.22)
Atlantic salmon	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.09	(0.07)
Black crappie	0.03	(0.03)	0.00	(0.00)	0.25	(0.22)	0.00	(0.00)
Bowfin	0.03	(0.03)	0.03	(0.03)	0.40	(0.40)	0.00	(0.00)
Brook trout	0.03	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Brown bullhead	6.41	(3.16)	0.76	(0.50)	6.67	(3.51)	2.56	(1.36)
Brown trout	0.03	(0.03)	0.00	(0.00)	0.03	(0.03)	0.09	(0.07)
Burbot	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)
Carp	0.16	(0.08)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)
Channel catfish	0.00	(0.00)	0.00	(0.00)	0.09	(0.05)	0.00	(0.00)
Chinook salmon	0.00	(0.00)	0.03	(0.03)	0.46	(0.29)	0.08	(0.05)
Coho salmon	0.03	(0.03)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)
Freshwater drum	0.00	(0.00)	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)
Gizzard shad	0.00	(0.00)	0.00	(0.00)	0.12	(0.12)	0.05	(0.05)
Lake herring	14.12	(5.13)a	22.40	(11.20)a	18.98	(8.34)a	9.80	(3.40)a
Lake sturgeon	0.99	(0.96)	0.03	(0.03)	0.09	(0.05)	0.00	(0.00)
Lake trout	0.00	(0.00)	0.31	(0.31)	0.00	(0.00)	0.00	(0.00)
Longnose gar	0.00	(0.00)	0.03	(0.03)	0.06	(0.04)	0.00	(0.00)
Longnose sucker	0.94	(0.51)	1.07	(0.49)	4.26	(2.46)	2.85	(1.33)
Menominee	0.83	(0.44)	0.52	(0.30)	0.00	(0.00)	1.49	(0.55)
Northern hog sucker	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.05	(0.05)
Northern pike	9.04	(1.77)a	8.07	(1.31)a	12.69	(2.11)a	9.26	(1.64)a
Pink salmon	0.00	(0.00)	0.00	(0.00)	2.78	(1.38)	0.55	(0.20)
Rainbow smelt	4.97	(2.45)	1.64	(0.69)	1.02	(0.47)	0.86	(0.50)
Rainbow trout	0.03	(0.03)	0.13	(0.07)	0.22	(0.22)	0.00	(0.00)
Redhorses	0.65	(0.29)	0.55	(0.20)	0.62	(0.17)	1.69	(0.53)
Rock bass	6.20	(2.25)	2.29	(0.67)	11.67	(2.42)	5.57	(1.35)
Sculpin	0.05	(0.04)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Sea lamprey	0.00	(0.00)	0.03	(0.03)	0.00	(0.00)	0.12	(0.09)
Smallmouth bass	0.89	(0.45)ac	0.26	(0.14)a	4.66	(2.23)b	3.77	(0.95)bc
Splake	0.34	(0.19)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Sunfishes	0.13	(0.08)	0.13	(0.11)	1.54	(0.89)	0.65	(0.47)
Tiger musky	0.00	(0.00)	0.68	(0.43)	0.00	(0.00)	0.00	(0.00)
Walleye	4.27	(1.56)a	4.14	(1.73)a	7.47	(1.92)a	3.92	(0.83)a
White sucker	21.48	(3.94)	13.85	(2.20)	25.68	(5.46)	20.00	(2.47)
Whitefish	1.15	(0.41)	0.55	(0.25)	2.10	(0.99)	0.73	(0.37)
Yellow perch	23.02	(6.28)a	25.68	(4.93)a	49.48	(7.16)b	29.97	(5.85)a

Table 2.–Mean (SE) CPUE for target species taken at various locations in St. Marys River 1975 to 1995. Means with no letter in common are significantly different. Comparisons are among years within an area.

Species	Areas sampled					
Year	Upper River	Lake Nicolet	Lake George	Lake Munuscong	Raber Bay	Potagannissing Bay
Yellow perch						
1995	39.0 (17.2)a	21.6 (10.2)a	42.3 (22.6)a	20.3 (2.5)ab	27.0 (6.8)ab	29.6 (11.5)a
1987	33.9 (15.9)a	30.4 (27.1)a	65.0 (19.0)a	30.0 (4.9)b	41.4 (4.8)b	62.5 (16.3)a
1979	43.1 (9.0)a	18.9 (9.5)a	26.2 (11.0)a	9.2 (2.1)a	9.8 (5.0)a	37.3 (11.7)a
1975	25.3 (16.6)a	13.9 (10.0)a	31.8 (10.0)a	11.2 (6.0)ab	6.0 (3.6)a	33.5 (16.4)a
Northern pike						
1995	2.5 (1.6)a	8.1 (3.4)a	16.3 (4.5)a	18.4 (5.5)a	12.8 (3.4)a	1.6 (1.2)a
1987	6.9 (5.0)a	2.9 (2.1)a	27.0 (5.2)a	15.6 (3.0)a	11.7 (3.2)a	8.0 (3.0)b
1979	1.9 (0.3)a	4.7 (3.5)a	14.3 (3.3)a	11.8 (4.6)a	6.0 (2.6)a	6.5 (1.4)b
1975	4.4 (4.0)a	11.7 (7.1)a	17.3 (7.8)a	9.3 (2.6)a	5.0 (3.0)a	7.1 (2.4)b
Walleye						
1995	2.5 (0.8)a	5.6 (3.1)a	2.0 (6.9)a	2.8 (0.9)a	3.6 (1.1)a	5.4 (2.1)a
1987	1.1 (0.7)a	0.8 (0.0)a	8.0 (3.5)a	3.1 (1.4)a	21.9 (8.0)a	6.3 (2.4)a
1979	0.0 (0.0)a	1.1 (0.7)a	4.0 (2.8)a	2.9 (1.0)a	5.6 (2.8)a	6.3 (4.8)a
1975	0.0 (0.0)a	4.7 (2.0)a	5.0 (4.0)a	2.9 (1.8)a	2.1 (1.4)a	6.5 (4.1)a
Smallmouth bass						
1995	0.0 (0.0)a	3.1 (3.1)a	3.5 (2.0)ab	8.1 (2.8)a	5.9 (4.5)ab	2.5 (1.0)a
1987	0.6 (0.3)a	2.1 (1.2)a	15.5 (10.6)a	7.9 (5.3)a	2.3 (0.4)a	0.2 (0.1)a
1979	0.0 (0.0)a	0.0 (0.0)a	0.0 (0.0)b	0.3 (0.3)b	0.0 (0.0)b	0.6 (0.4)a
1975	0.0 (0.0)a	0.0 (0.0)a	0.3 (0.2)b	1.8 (1.2)ab	0.0 (0.0)b	1.4 (1.1)a
Lake herring						
1995	0.0 (0.0)a	13.4 (5.9)a	3.5 (3.2)a	0.0 (0.0)a	11.7 (9.3)a	19.2 (9.8)a
1987	0.0 (0.0)a	0.8 (0.8)a	3.3 (2.9)a	0.8 (0.6)b	1.2 (1.0)a	54.0 (21.1)a
1979	0.0 (0.0)a	3.1 (3.1)a	0.0 (0.0)a	0.0 (0.0)a	62.7 (62.4)a	39.8 (23.8)a
1975	0.0 (0.0)a	9.2 (8.3)a	0.0 (0.0)a	0.1 (0.1)c	42.5 (17.8)a	23.0 (11.7)a

Table 3.–Mean CPUE of smelt, alewife and lake herring in small mesh gill nets in St. Marys River during the spring 1995.

Species	Month	Baie de Wasai	Below Rock Cut	Lake Munuscong
Smelt	April	0.00	0.00	0.00
	May	0.00	0.00	0.00
	June	0.00	0.00	0.00
Alewife	April	0.00	0.00	0.00
	May	0.00	0.00	0.00
	June	0.00	0.50	0.25
Lake herring	April	2.75	0.75	0.75
	May	1.50	0.25	1.67
	June	11.75	1.25	0.25

Table 4.–Total mortality rates for key fish species in St. Marys River, August 1995.

				Mortality	
Species	Area	Number of fish	Age range	(A)	(Z)
Yellow perch	Upper River	69	4-10	0.25	0.28
	Lake Nicolet	57	4-8	0.38	0.47
	Lake George	82	4-8	0.40	0.51
	Lake Munuscong	65	4-9	0.41	0.53
	Raber Bay	53	4-8	0.44	0.57
	Potagannissing Bay	107	4-8	0.60	0.92
	All	433	4-10	0.38	0.47
Northern pike	All	205	2-9	0.58	0.87
Walleye	All	80	4-10	0.51	0.70
Lake herring	Less Potagannissing	94	2-10	0.30	0.36
	Potagannissing Bay	115	2-9	0.55	0.79
	All	226	3-10	0.31	0.37
Smallmouth bass	All	36	4-8	0.36	0.45

Table 5.–Walleye age composition (number and frequency), average length at age, overall average length, average age, and growth index from previous surveys from areas of St. Marys River, August 1995. All lengths in mm.

Area	Age										Growth	Average	Average
Parameters	1	2	3	4	5	6	7	8	9	10	index	length	age
Potagannissing													
Number		5	14	7	2	2				1			
Frequency (%)		16.1	45.2	22.6	6.5	6.5				3.2			
Average length		221	211	327	470	508				591	-134	305	3.6
Average lengths from previous surveys:													
1987 survey	249	279	322	371	434	482		591				388	4.2
1979 survey		307	378	447	472	528	513	538			-27	442	5.3
River wide													
Number	2	14	25	22	11	3		1		2			
Frequency (%)	2.5	17.5	31.3	27.5	13.8	3.8		1.3		2.5			
Average length	212	211	246	304	445	522		612		604	-100	314	3.7
State average	249	338	386	437	472	515	541	561	581	–			

Table 6.–Condition of target species by area in St. Marys River, August 1995. Values are mean relative weight except for lake herring which is mean relative condition factor and mean visceral fat index in parentheses. Means with no letter in common are significantly different for comparisons between areas within a species.

Location	Walleye	Yellow perch	Smallmouth bass	Northern pike	Lake herring
Upper River	97.0ab	100.8ac	–	99.2ab	– (–)
Lake Nicolet	89.3bc	99.5ac	114.0a	96.7b	1.13 (2.2) b
Lake George	95.2abc	97.3a	105.6a	91.1ab	1.41 (0.6) a
Lake Munuscong	76.8c	101.3ac	106.4a	89.9ab	0.88 (0.0) bc
Raber Bay	94.7ab	102.0c	106.9a	86.6a	1.03 (2.9) bc
Potagannissing Bay	117.6a	90.6b	102.7a	101.6b	0.93 (2.1) c
River wide	102.2	97.1	106.1	91.4	1.03 (2.0)

Table 7.–Mean relative weight by size class for target species from St. Marys River, August 1995. Means with no letter in common are significantly different for comparisons between size classes within species.

Species	Stock	Stock to quality	Quality to preferred	Preferred to memorable	Memorable to trophy
Walleye	137.5a	90.7b	91.7b	89.4b	–
Yellow perch	–	95.1a	101.8b	96.5a	94.8ab
Smallmouth bass	–	106.7a	106.4a	104.9a	–
Northern pike	93.2a	91.8a	90.8a	–	–

Table 8.–Proportional Stock Density and Relative Stock Density by size class (preferred, memorable, trophy) for target species from St. Marys River, August 1995.

Species	Recommended PSD range	PSD	RSDp	RSDm	RSDt
Yellow perch	30 - 50	45	19	3	0
Walleye	30 - 60	56	18	0	0
Smallmouth bass	30 - 60	69	32	0	0
Northern pike	30 - 60	31	1	0	0

Table 9.–Incidence and percent of occurrence of food items for target species from St. Marys River, August 1995. Percent prey item is in parentheses.

	Walleye		Lake herring		Northern pike		Smallmouth bass		Yellow perch	
Incidence										
No. stomachs examined	80		235		205		39		388	
% void	46.2		55.7		51.7		33.3		39.2	
Percent of Occurrence										
Unidentified fish	57.1	(39.5)	–		50.5	(38.9)	19.2	(18.8)	37.7	(37.2)
Crayfish	9.5	(4.9)	–		7.1	(1.8)	50.0	(28.1)	42.8	(26.0)
Alewife	11.9	(9.9)	1.0	(1.3)	4.0	(3.7)	–		0.4	(0.7)
Smelt	21.4	(37.0)	–		11.1	(10.2)	19.2	(15.6)	0.8	(0.7)
Nine spine stickleback	2.4	(1.2)	–		12.1	(21.3)	–		3.4	(2.6)
Trout-perch	2.4	(1.2)	–		7.1	(4.6)	7.7	(15.6)	0.4	(0.4)
Slimy sculpin	9.5	(6.2)	–		8.1	(4.6)	7.7	(3.1)	10.6	(9.3)
Other invertebrates	–		4.0	(0.6)	–				5.1	(19.0)
Unidentified plankton	–		80.2	(97.2)	–		–		–	
Spiny water flea	–		14.8	(0.8)	–		–		–	
Mayflies	–		–		–		3.8	(18.8)	2.1	(3.7)
Caddis flies	–		1.0	(<0.1)	–		–		–	
Johnny darter	–		–		–		–		9.4	(0.4)
Coho salmon	–		–		1.0	(0.9)	–		–	
White sucker	–		–		5.0	(4.6)	–		–	
Smallmouth bass	–		–		1.0	(0.9)	–		–	
Yellow perch	–		–		15.2	(7.4)	–		–	
Walleye	–		–		1.0	(0.9)	–		–	

Table 10.–Percent lamprey wounding and scarring for target species from St. Marys River, August 1995.

Species	N	Fresh wound	Scar
Walleye	76	0.0	1.3
Lake herring	254	1.6	4.7
Northern pike	201	0.0	1.0
Smallmouth bass	41	0.0	0.0
Yellow perch	718	0.0	0.0

Table 11.–Northern pike age composition (number and frequency), average length at age, overall average length, average age, growth index, and length at age from previous surveys from areas of St. Marys River, August 1995. All lengths in mm.

Area	Age										Growth	Average	Average
Parameters	1	2	3	4	5	6	7	8	9	10	index	length	age
Lake Nicolet													
Number		12	11	2	1								
Frequency (%)		46.2	42.3	7.7	3.8								
Average length		485	530	587	662						-37	519	2.7
Average lengths from previous surveys:													
1987 survey	233	310	490		637			673			-38	490	4.2
1979 survey			419	530	635	667						459	3.4
Lake George													
Number	16	31	11	5	3	1							
Frequency (%)	23.9	46.3	16.4	7.5	4.5	1.5							
Average length	411	478	561	597	635	792					-25	496	2.3
Average lengths from previous surveys:													
1987 survey	411	477	530	579	716						-38	485	2.5
1979 survey	322	391	434	482	558	604	622					475	3.8
Lake Munuscong													
Number	20	31	4	5	3								
Frequency (%)	31.7	49.2	6.3	7.9	4.8								
Average length	3.1	452	495	612	591						-37	455	2.0
Average lengths from previous surveys:													
1987 survey	424	452	528	558	695						-47	495	2.6
1979 survey			480									480	3.2
Raber Bay													
Number	6	20	4	5					1				
Frequency (%)	16.7	55.6	11.1	13.9					2.8				
Average length	398	477	530	586					1034		-36	483	2.4
Average lengths from previous surveys:													
1987 survey		454	497	558	659						-71	510	3.2
1979 survey		442	482	513	614							475	3.4
River wide													
Number	42	98	35	21	7	2	1		1				
Frequency (%)	20.3	47.3	16.9	10.1	3.4	1.0	0.5		0.5				
Average length	400	469	537	609	620	723	919		1034		-39	488	2.3
State average	421	510	579	635	683	731	779						

Table 12.–Yellow perch age composition (number and frequency), average length at age, overall average length, average age, growth index, and length at age from previous surveys from areas of St. Marys River, August 1995. All lengths in mm.

Area	Age										Growth	Average	Average
Parameters	1	2	3	4	5	6	7	8	9	10	index	length	age
Upper River													
Number			1	7	15	8	4	20	17	2			
Frequency (%)			1.4	9.5	20.3	10.8	5.4	27.0	23.0	2.7			
Average length			193	201	241	244	269	282	299	355	-5	266	7.0
Average lengths from previous surveys:													
1987 survey				201	216	223	254	264	305	312	-20	201	5.1
1979 survey			183	201	216	259	256	302	294			228	5.3
Lake Nicolet													
Number			7	10	16	12	7	5					
Frequency (%)			12.3	17.5	28.1	21.1	12.3	8.8					
Average length			178	213	231	251	274	295			0	236	5.3
Average lengths from previous surveys:													
1987 survey				195	221	231	287	294			-8	226	5.2
1979 survey			168	185	221	208	244					188	4.1
Lake George													
Number			4	23	20	16	12	7					
Frequency (%)			4.9	28.0	24.4	19.5	14.6	8.5					
Average length			191	211	234	249	244	264			-10	232	5.4
Average lengths from previous surveys:													
1987 survey				198	216	256	264	302	322		-10	239	5.7
1979 survey			173	190	203	249	282					216	5.2
Lake Munuscong													
Number			3	19	17	15	6	3	2				
Frequency (%)			4.6	29.2	26.2	23.1	9.2	4.6	3.1				
Average length			183	216	231	241	256	292	279		-8	233	5.3
Average lengths from previous surveys:													
1987 survey				195	226	279	292	325			5	244	5.4
1979 survey			203	193	216	239	284	254				211	3.7
Raber Bay													
Number		2	5	17	13	7	5	4					
Frequency (%)		3.8	9.4	32.1	24.5	13.2	9.4	7.5					
Average length		185	208	228	254	261	266	269			12	239	4.9
Average lengths from previous surveys:													
1987 survey			165	188	231	251	277	297	307	215	-8	244	5.9
1979 survey			195	221	272	261						223	4.1
Potagannissing													
Number		9	46	30	14	5	2	1					
Frequency (%)		8.4	43.0	28.0	13.1	4.7	1.9	0.9					
Average length		183	175	208	226	264	274	29			3	199	3.7
Average lengths from previous surveys:													
1987 survey					231	261	272	307		330	-5	256	6.1
1979 survey			201	223	249	269	302	322	282			233	4.6
River wide													
Number		11	63	87	78	48	30	37	17	2			
Frequency (%)		2.9	16.9	23.3	20.9	12.9	8.0	9.9	4.6	0.5			
Average length		183	179	213	237	252	260	279	299	355	-1	231	5.1
State average	127	160	183	208	233	256	277	292	302	–			

Table 13.–Lake herring age composition (number and frequency), average length at age, overall average length, average age and growth index from Potagannissing Bay and St. Marys River, August 1995. All lengths in mm.

Area	Age										Growth	Average	Average
Parameters	1	2	3	4	5	6	7	8	9	10	index	length	age
Potagannissing													
Number	25	84	9	7	3	4	4	2	2				
Frequency (%)	17.9	60.0	6.4	5.0	2.1	2.9	2.9	1.4	1.4				
Average length	206	274	330	351	399	391	391	411	406		37	283	2.5
River wide													
Number	27	106	25	17	12	14	13	6	3	3			
Frequency (%)	11.9	46.9	11.1	7.5	5.3	6.2	5.8	2.7	1.3	1.3			
Average length	206	276	331	295	348	393	400	408	412	447	25	301	3.2
State average	213	241	266	294	320	348	373	401	–	–			

Table 14.–Smallmouth bass age composition (number and frequency), average length at age, overall average length, average age, and growth index from St. Marys River, August 1995. All lengths in mm.

Area	Age										Growth	Average	Average
Parameters	1	2	3	4	5	6	7	8	9	10	index	length	age
River wide													
Number	2		4	8	9	11	12	14					
Frequency (%)	3.3		6.7	13.3	15.0	18.3	20.0	23.3					
Average length	151		249	262	279	306	344	359			-101	307	5.9
State average	178	256	305	355	386	406	434	452	475				

Table 15.–Commercial harvest (in kg) from the mouth of the St. Joseph Channel and northern half of Potagannissing Bay, 1991 to 1995. From David McLeish, Ontario Ministry of Natural Resources, personal communication.

	Year					
Species	1991	1992	1993	1994	1995	5 year total
Lake sturgeon	40	95	0	88	110	333
Other salmon & trout	95	0	0	0	0	95
Pink salmon	1,411	30	1,358	294	1,219	4,312
Coho	0	0	0	36	4	40
Chinook	22	87	179	21	77	386
Rainbow trout	0	0	0	1	3	4
Atlantic salmon	0	0	89	0	0	89
Brown trout	0	0	0	2	5	7
Lake trout	220	207	953	681	764	2825
Lake whitefish	8,462	8,498	38,579	10,729	6,739	73,007
Lake herring	15,685	4,324	3,059	852	1,115	25,035
Menominee	46	75	29	2	1	153
Chub	0	0	0	3	0	3
Rainbow smelt	0	0	0	33	0	33
Northern pike	157	690	178	144	222	1391
Sucker family	2,723	4,783	3,480	1,665	0	12,651
Carp	60	471	124	181	0	836
Channel catfish	110	139	19	34	0	302
Burbot	0	0	0	4	0	4
Yellow perch	26	70	1	1	2	100
Walleye	6,661	9,009	6,664	6,249	5,783	34,366

Table 16.–Harvest (in kilograms) reported by Sault Ste. Marie Tribe of Chippewa Indian licensed subsistence fishers of various fish species from St. Marys River during calendar year 1995 (Mark Ebener, COTFMA, personal communication).

Month	Location in river	Walleye	Suckers	Northern pike	Whitefish	Brown trout	Atlantic salmon	Carp	Total
January	Munuscong	5							5
March	Upper River		5	5	2	1	1		14
May	Lake George	45	48	18				4	115
June	unknown			2					2
November	Bai de Wasai		4	4					8
Total		50	57	29	2	1	1	4	144

Table 17.–Fish species and number stocked from 1983 to 1995 at various locations in St. Marys River by agency.

Species Location	Age[a]	Agency[b]	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Atlantic salmon															
Soo, above Rapids	Y	LSSU								950					
Soo, below Rapids	Y	LSSU							18,569	31,902	3,114	29,398	47,716	20,518	29,060
	FF	LSSU								601		2,305			25,072
Brown trout															
Soo, above Rapids	Y	SSMMH									8,281		35,321	10,562	
	FF	SSMMH										40,309		32,743	43,567
Soo, above Rapids	Y	MDNR	19,900	9,500	13,500	15,000	15,000	15,000	13,500	14,999	15,000				
	FF	MDNR								26,086		30,000			
Soo, below Rapids	Y	MDNR							1,500			14,500			
Soo, below Rapids	Y	SSMMH								22,201	10,544	35,035	32,048	35,899	
Soo, below Rapids	FF	MDNR										54,705			
	FF	SSMMH												46,824	59,260
Raber	FF	MDNR										20,000			
Chinook salmon															
Soo below Rapids	SF	LSSU		4,063											
Detour	SF	MDNR			50,000										
Soo, below Rapids	SF	SSMMH						66,157	47,162	42,020	53,239	123,206	154,919	103,637	98,194
Soo, below Rapids	SF	MDNR	100,000	129,230	93,002	131,000	101,968	100,000	125,244	98,000	86,701	75,266	88,231	102,000	199,392
Soo, above Rapids	Y	SSMMH							44,205	17,557					
Lake trout															
Drummond Island	Y	MDNR			113,399	50,000	80,300								
Soo, below Rapids	SF	MDNR					2,000								
Rainbow trout															
Soo. above Rapids	FF	MDNR										199,979			
Soo, below Rapids	FF	SSMMH							22,816	20,344	2,958	35,897	75,143	54,247	34,558
Soo, below Rapids	Y	MDNR			19,918	19,700	27,629	20,000	18,200	24,994	18,900	29,300	24,000	21,100	22,600
Soo, above Rapids	Y	SSMMH							1,014	1,250	1,900	1,400	2,784	1,840	
Soo, above Rapids	FF	SSMMH			29,899				17,500			199,978			
Soo, below Rapids	Y	LSSU						3,500	12,357						
Soo, below Rapids	FF	LSSU					14,000							2,500	
Munuscong & Pottaganassing	Y	SSMMH							1,027	1,000		1,500	1,000	1,436	

Table 17.–Continued.

Species Location	Age[a]	Agency[b]	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Steelhead															
Soo, below Rapids	Y	MDNR	30,000	7,000	16,012	219,000	15,000	11,500	10,951	10,310	9,566	10,000	19,928	22,300	21,500
	FF	MDNR										38,900			
Northern pike															
Potagannissing Bay	FF	MDNR	15,000	13,000	13,500										
Walleye															
Waiska Bay	SF/FF	COFTMA				50,442		19,081		2,740	7,038	80,895	106,787	109,225	127,339
Soo, above Rapids	SF/FF	MDNR			26,567	25,334		20,000	52,300	29,419	25,067	25,255		50,493	
Soo, below Rapids	SF/FF	MDNR			29,982	25,334		20,651	47,671	56,721	25,023	25,179		77,555	
Lake Munuscong	SF/FF	MDNR								7,200		60,505		13,500	
Raber Bay	SF/FF	MDNR										101,837			
Potagannissing Bay	SF/FF	MDNR				89,391	85,429	81,060	127,659	101,970		140,653		144,750	
Total stocked per year			164,900	162,793	405,779	625,201	341,326	356,949	561,675	510,264	267,331	1,376,002	587,877	851,129	660,542

[a] Ages: SF=Spring fingerling (less than a year old, stocked before July 1), FF=Fall fingerling (stocked after July 1), Y=Yearling fish

[b] LSSU (Lake Superior State University, Aquatics Laboratory) Roger Greil, LSSU, personal communication
SSMMH (Sault Ste. Marie, Ontario Municipal Hatchery) (closed in 1995), Sue Greenwood, OMNR, personal communication
COTFMA (Chippewa/Ottawa Treaty Fishery Management Authority), Greg Wright, COTFMA, personal communication
MDNR (Michigan Department of Natural Resources), stocking records

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Appendix 1.–Common and scientific names of fishes and aquatic invertebrates mentioned in this report.

Common name	Scientific name
Atlantic salmon	*Salmo salar*
Black crappie	*Pomoxis nigromaculatus*
Bowfin	*Amia calva*
Brook trout	*Salvelinus fontinalis*
Brown bullhead	*Ictalurus nebulosus*
Brown trout	*Salmo trutta*
Burbot	*Lota lota*
Caddisfly	*Trichoptera spp.*
Carp	*Cyprinus carpio*
Channel catfish	*Ictalurus punctatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Chub	*Coregonus hoyi*
Coho salmon	*Oncorhynchus kisutch*
Crayfish	*Astacidae spp.*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Johnny darter	*Etheostoma nigrum*
Lake herring	*Coregonus artedii*
Lake Sturgeon	*Acipenser fulvescens*
Lake trout	*Salvelinus namaycush*
Lamprey	*Petromyzon marinus*
Longnose sucker	*Catostomus catostomus*
Mayfly	*Ephemeroptera spp.*
Menominee	*Prosopium cylindraceum*
Ninespine stickleback	*Pungitius pungitius*
Northern hogsucker	*Hypentelium nigricans*
Northern pike	*Esox lucius*
Pink salmon	*Oncorhynchus gorbuscha*
Rainbow smelt	*Osmerus mordax*
Rainbow trout	*Oncorhynchus mykiss*
Redhorse spp.	*Moxostoma*
Slimy sculpin	*Cottus cognatus*
Spiny water flea	*Bythotrephes cederstroemi*
Splake	*S. fontinalis x s.namaycush*
Trout-perch	*Percopsis omiscomaycus*
Walleye	*Stizostedion vitreum*
White sucker	*Catostomus commersoni*
Whitefish	*Coregonus clupeaformis*
Yellow perch	*Perca flavescens*

Appendix 2.–Length-weight equations for target species from St. Marys River, August 1995. Weight (W) in g and total length (L) in mm.

Species	Equation	r^2	N
Walleye	$W = 4.7413x10^{-5} L^{2.7310}$	0.96	91
Yellow perch	$W = 2.6720x10^{-6} L^{3.3039}$	0.96	839
Smallmouth bass	$W = 6.3910x10^{-6} L^{3.1544}$	0.96	65
Northern pike	$W = 6.3940x10^{-6} L^{2.9903}$	0.88	234
Lake herring	$W = 6.2470x10^{-6} L^{3.0799}$	0.92	270